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Sept. 11, 1915

THE CONSTRUCTION
TUNING AND CARE
OF THE
PIANO-FORTE

BY

EDWARD QUINCY NORTON

OLIVER DITSON COMPANY
BOSTON

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NEW YORK

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CHICAGO

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PREFACE.

THE Author's aim has been to furnish a Book of Reference for tuners, dealers, musicians, and owners in general of pianos and organs, giving the result of years of study and practical experience of the writer, together with the results of the latest researches of scientists, and the improvements of manufacturers. No attempt has been made to explain the scientific theory of sound. All interested in the study of this subject are referred to "Tyndall's Lectures on Sound," the works of Helmholtz, Koenig, Preyer, Bosanquet, and other great acousticians and scientists. To avoid confusing the reader, by presenting various schemes for "laying the bearings" in tuning, a method of temperament is given, which invariably insures the best results, within the smallest compass, and on that part of the piano where the beats are most easily perceived and followed by the ear. Suggestions from manufacturers, dealers, and tuners of experience will be kindly received and appreciated, that future editions of this work may be as accurate and complete as possible.

THE AUTHOR.

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CONSTRUCTION, TUNING, AND CARE
OF THE
PIANO-FORTE.

CHAPTER I.

Defects in the English Action—How to Remedy Them.

DESCRIPTION OF ACTION.

The following are defects peculiar to this construction of action, and are in addition to faults common to both this and the French action. The principal difference between the old English action, and the present so called French action of the modern square piano is, that, in place of the rocker and jack of the latter, the English action has what is called the "fly," fastened by parchment hinge into a base, which in turn, is mortised and glued solidly into the key.

Through the fly runs the regulating screw, the button of which presses against the cushioned surface of extended base; the turning in or out of the screw, regulating the fall of the hammer.

In the front of the base, below the fly, is fastened a curved spring, which bears against the fly which throws up the under hammer, or hopper; when key is depressed, this hopper forces up the hammer which strikes the string.

The movement of this fly upon the hopper is the reverse of the jack in the French action.

This action, while having many good points, does not admit of so exact regulating. The way of taking up lost motion, between top of fly and hopper, being to lower hopper-rail, and as this is a continuous strip, cushioned, running under all the hoppers, it necessarily changes all when perhaps only one or more hoppers may need the alteration. See "defects and how to remedy."

Besides the above difference noted, the English action has levers back of keys, and under wrest-pin block, the front ends of which rest on the rear end of key, and into an upright movable arm of the lever, is screwed damper wire.

The back end of levers hinge on parchment, same as fly. When key is depressed, hammer is thrown up, and damper is raised from string and held up, so long as key remains down.

A HAMMER BLOCKS

When the fly is too far under the hopper. Regulate by screw in fly.

When the fly spring is too weak. Strengthen by curving it.

When the hopper check is too high. Lower it.

When the top of hopper, or under side of hammer shank is not smooth. Smooth, and black lead.

A FLY STICKS

Against the hopper when hopper leather is rough, or worn.

When the fly spring is too strong. Weaken by drawing fly forward.

When it moves sluggish in the groove. Black lead the groove.

When it has worked to one side of the hopper.

When the parchment hinge is broken.

Remedy as required in above.

DAMPERS RATTLE.

Dampers rattle when the wire is loose in damper head. Plug up hole and bore new one.

When damper socket (wooden) is broken. Mend with cloth, or leather, to hold firm.

When damper wire rattles against strings. If fault is in socket, or bushing, remedy as above; if fault is in back bridge pins being out of position, allowing string to press against wire, remedy as directed in rattling strings.

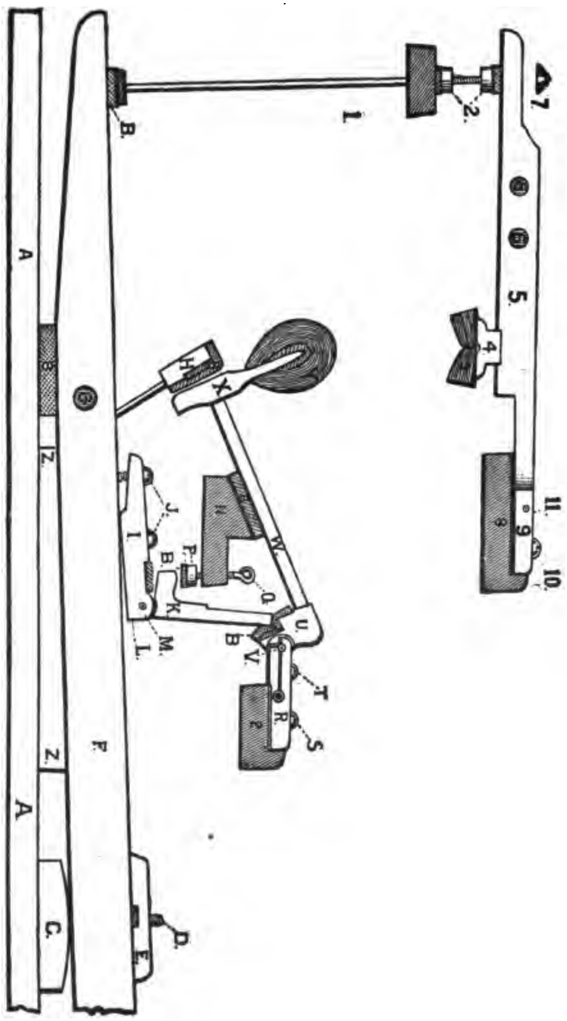
TO TAKE UP LOST MOTION.

If on single keys, glue thin card-board, or paper of required thickness, on under surface of hammer shank, which rests on hopper, and polish with black lead.

Or better; re-cover the hopper, or under hammer, with thicker leather.

If all the keys have lost motion, new and thicker leather is the proper remedy.

These are the principal defects peculiar to the English action.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French Action of Square Piano.

A. Action Frame.
B's Indicate the Cushions, or Bushing, of cloth, felt, or leather, upon which the various parts rest, or fall noiselessly.
C. Centre or Balance Rail.
D. Balance Rail Pin. Round. (Guide Pin in front end of key, oval in modern pianos.)
E. Mortised Cap for Balance Rail Pin. Bushed.
F. Key.
G. Key Lead.
H. Back Catch.
I. Rocker.
J. Rocker Screws; used to regulate height of Jack.
K. Jack.
L. Jack Spring; concealed under Rocker.
M. Centre Pin to Jack.
N. Stem Rail.
O. Regulating Screw.
P. Regulating Button.
Q. Flange Rail.
R. Flange. Split.
S. Flange Rail Screw.
T. Flange Screw, to regulate jaws of flange.
U. Hammer Heel.
V. Centre Pin.
W. Hammer Stem.
X. Hammer.
Y. Hammer Head. Felt. Treble notes sometimes capped with Buckskin.
Z. Lines showing position of Key Cheek.

Top Action of Square Piano.

1. Damper Lifter Wire.
2. Damper Lifter Buttons.
3. Damper Felt.
4. Damper Head.
5. Damper Lever.
6. Damper Leads.
7. Shade, supported by wire stanchions, on top of which are screwed shade buttons.
8. Damper Rail.
9. Flange.
10. Flange Screw.
11. Damper Lever Centre Pin.

The *Trap Action* consists of Pedal, Pedal Brace, Pedal Feet, Pedal Rods, Roller Boards, or Elbows, Studs, Plugs, Trap Springs, Wires, and Lifter Rods.

CHAPTER II.

INSTRUCTIONS FOR TAKING OUT FRENCH ACTION OF SQUARE PIANOS.

IN some makes, the action is held in place by long square headed screws, entering from the under side of the piano.

In others, by screws through the key frame, under the keys. To get at these, it will be necessary to slide up the name board, when the location of screws will be indicated by marks on the keys.

In most of square pianos, the screws will be found entering front of key frame under the keys, immediately back of the key strip.

This key strip is held in place by dove-tailed grooves, fitting over the head of screws in the front of action frame, and can be slid up, exposing the screws and wire handle, which latter will be found in the centre of key frame.

Having seen that there are *no hammers up*, draw the action carefully forward: when nearly out, place the right hand under the action front, and, with the left hand, grasp the flange rail a little to the left of the middle, partly supporting the weight of the action on the left leg, and then proceed to draw the action out.

If the action sticks in the case, insert a strong cloth, or towel, in the wire handle, and a few sudden jerks will start the action forward.

The greatest care must be used, both in taking out the action and replacing it, or the hammers, or hammer stems, will be broken by coming in contact with the sound-board, or frame.

If action sticks in case, it may require key cheeks, action frame, and action supports at ends, planed, to free its sliding in and out; and to prevent frame, or case, cramping action. Yellow soap, or soap and black lead, may be used also.

CHAPTER III.

DEFECTS OF FRENCH ACTION, AND HOW TO REMEDY.

THE KEYS STICK

When the mortise, or bushing, binds upon either the centre or guide pin. Free it with a fine file; or better, carefully enlarge the hole, by inserting pointed end of tuning-fork, to press back the wood, or bushing.

If guide pin is oval, and the key sticks there, see if pin is not turned too far, or does not strike end of mortised hole. In enlarging the hole, be very careful, or the key will be liable to rattle. Use a tapering pointed fork.

When the keys touch the studs, or action rail supports, or cheeks. Remedy as for keys interfering.

When one key interferes with another, consider whether the key pins are in a proper position, if so, plane off the key, or keys, as required. If the key is considerably warped, straighten it with a hot iron; or by hammering on the side of the key desired to be drawn.

Warped keys will usually be found to be made of two pieces of wood, where the boards are glued together in making up the key-board; and the whiter of the two pieces will draw the other.

One way to remedy this, is to plane off the concave side, and glue on a corresponding thickness of wood upon the convex side, to retain the proper thickness of key; setting the rocker over on the key, if required to bring the jack again directly under the heel of hammer. The only sure way to prevent further warping is to saw through the white piece of the key, and glue in wedges. This cuts off the fibres of the wood, and the wedges, properly fitted and driven, will straighten the key; make it as strong as before; prevent the white or closer grained wood pulling; or the dark and coarser grained from pushing, by expanding through greater absorption of moisture. This defect is confined almost exclusively to keys of square pianos.

In gluing up the pieces of which the key-boards of uprights and grands are now made, the widths of the boards are so gauged that the line of division between the keys comes at the place where boards were matched, thus preventing the key being made of two pieces; besides, the keys being shorter, and running straight, or nearly so, are less liable to this defect.

Keys stick when anything is between them. Remove the obstruction.

When they touch the key strip. If only one, or at most a few keys touch the key strip, the trouble will most likely be found in the key; either the front of key has unglued, and warped; or the balance rail pin is loose, out of position; or the hole in the key may have become enlarged, allowing key to slide forward.

For any of above defects, the proper remedy will suggest itself.

If any considerable number of keys touch the key strip the fault is in the key strip, which may require larger headed screws in the key frame, over which to slide the dove-tailed key strip; or it may be found best to bevel off the inside of key strip.

Keys stick when too light behind the balance rail. Insert another lead button, and hammer it until tight, using care that the key is not split.

When some glutinous substance is under the key.

When the key leads are corroded, and interfere with adjoining keys. Cut away the protruding lead.

When the key (ebony) touches the name board, or cloth cushion of same. Saw or file off the back end of the ebony, unless the fault should be found to be at the balance rail pin, as above noted, or in a warped or otherwise defective name board.

When the ivory, or ebony, touches that of the next key. Remedy by needed attention at the key pins, to properly space the key. Then, if required, file the sides of ivory, or ebony, as needed.

When the name board cushion rests upon the keys, so much as to prevent their full return, thus preventing the jack from falling under the hammer heel.

When bed, or bottom, of case has twisted, or sprung, so as to cramp action frame. Level bed carefully, and pare off key cheeks.

The first thing to do in regulating a piano, is to see that bed is perfectly level. If there is a depression through the centre, balance rail will fall, thus causing shallow touch.

Keys stick when damper wire is too long, or through other defects of damper action. (See "Damper Action Defects.")

Keys stick when jack spring is broken; when weak; when the jack spring thread has slipped between the side of jack and rocker. The remedy is self-evident.

When the pivot pin of jack is too tight in the rocker. Touch the bushing cloth on either side of rocker with a drop of water, and dry off quickly; or better, touch the bushing around both ends of the pin with a drop of clear white kerosene, or coal oil. Nothing but best refined kerosene oil must be used. This is an absolute protection for all tight joints in the piano against further sticking. Alcohol is also good.

Keys stick when rocker, or jack, projects to one side, and touches adjoining key, action props, or cheeks.

When pivot-pin of jack, works out of rocker and into next key. Replace and upset pin by light blows on both ends, holding same on anvil, or other metal surface.

When the back catch is pressed too far forward, so as to bind hammer in its ascent; or when leather or felt cushion, on back catch, has become unglued at either end; or when the cushion is worn through.

When the hammer heel sticks in the flange. If a split flange, relieve with regulating screw: if a solid flange, touch pivot pin with kerosene oil, or alcohol.

When the hammer heads interfere; or when the hammer heads strike the sound-board braces. See remedy for sticking hammers.

HAMMERS STICK

When they are too tight in the flange. Should rebound twice when let fall on stem rail. Regulate with screw, if a split flange: if a solid flange, use a drop of kerosene oil on bushing on either side of flange, or a drop of water, and dry off quickly. The oil is best, and is also a remedy for creaking joints.

Against the wrest block. If the key frame is in the right place, alter the position of single hammers by screw in the flange; unless fault should be in hammer head, in which case, remedy as required. Sometimes it is necessary to pare away the wrest block.

Hammers stick against each other.

If they are all in right place and interfere, from being flattened on top, and spread out on the sides, pare off the sides with a sharp knife; or better, if they are leather hammers, pinch up the sides with pliers, which will reduce their thickness, and round them up on top.

If they are felt hammers, and interfere badly, hold a piece of damp cotton cloth tightly over the hammer and down the sides, and go over them with a child's (toy) flat iron heated. This will steam the felt, and shape them same as when new. This is also a remedy when felt hammers are too soft.

So far as possible, avoid the cutting of hammers. If they once worked properly they can be made to do so again, without sacrificing any of the leather, or felt.

Hammers stick from the stem twisting the head around. See " Remedy for Twisting Stems in Upright Action."

KEYS RATTLE

When the mortises are too large. Wedge the key on each side of the mortise; or compress the wood on either side with a wooden punch, made three quarters the width of key, and a little longer than the length of the bushed hole. In one end of the punch, bore a hole to fit over the centre pin. Drive with a light hammer. Should any be driven too tight, relieve with pointed end of tuning-fork, as directed for sticking keys. If oval pins are used in the front rail, turn them until key is sufficiently tight.

Keys rattle when the cloth under them is hard. Renew the cloth.

When some foreign substance is on the cloth. Remove it.

When they touch the balance rail underneath. Shave them off; or if key is below general level, or if many of the keys touch balance rail, put on thicker punchings, same as for deepening the touch. This defect is caused by springing of the key through long continued use, and by compression, and wearing out of cloth punchings on the centre rail; or having been moth eaten. Sometimes it is necessary to true up the bottom of the key by planing off at both ends.

Keys rattle by friction one against another; or against the key strip in front; against the key cheeks; against the action frame cheeks and posts; against the soundboard wire brace; against the flange and stem rail stanchions, or misplaced damper wire. Remedy as directed for sticking keys, from same cause.

When the ivory, or ebony, is loose. Reglue it.

The best device for holding the ivory, or ebony, firmly on the key until glue has set, is an umbrella ring, No. 1 size, made of pure rubber. They are more easily applied than the steel springs used in factories, and hold the ivory, or ebony, perfectly even on key. For broken fretwork of music rack; rack supports; prop sticks; broken keys; loosened mortised block over centre pin; damper levers, and, in fact, wherever a firm compression is desired in gluing, and these rings can be applied, they will be found so desirable, that no tuning kit, or repair shop, will be thought complete without a few of them. In replacing ivory, head or tail, leave 1-8 inch joint end clear of all glue, to insure a close and clean joint of the head and tail.

When the key leads are loose. Hammer them till firm.

When the key is unsound, by reason of split: or when mortised block on top of key, at centre pin, is loose; or the hard piece of wood inserted in under side of key, at centre pin, is loose. In above cases, reglue, using rubber ring referred to above.

When the key cheeks are loose.

When the key frame is not firmly attached to the bottom of piano.

First, examine the screws, to see that they are tight, then even up the bed of piano, on which rests the action frame, by upholsterers brass headed tacks driven into the bottom of piano, under centre rail, where case is depressed; or by gluing card-board under centre rail.

Keys rattle when sharp edge of damper wire, not having been properly rounded, cuts through the cushion on which it rests, at the back end of the key, and strikes upon the wood of the key.

When the key touches the name board. This trouble is mainly confined to the black notes, and the remedy is the same as for sticking key, from this cause.

If many of the keys strike the name board, fault is most apt to be in the latter, which is warped or otherwise out of position.

When the ivory, or ebony, touches that of the next key. File it, unless fault should be in a misplaced key, from loose or bent centre, or guide pin.

When any hard, detached substance is on the key.

When a rocker is loose on a key. In tightening the rocker, do so with reference to properly adjusting the height of the jack under the hammer heel.

Even up the rocker, if one side has sunken deeper into the key than the other.

When a jack is loose on the pivot pin. Upset it, as directed in sticking keys, for pins working out; or insert larger wire if required.

Keys rattle when the cloth upon which they fall is hard, or has been eaten away by moths.

KEYS RATTLE FROM DEFECTIVE SOUND-BOARD.

If, when a key is struck, a click is heard at the moment the hammer strikes the string, take out the name, or finger board, so that a view can be had of the action in the case, and see if the sound-board has not fallen, so that the hammer stems hit the under side of the board; or that the heel of the hammer, does not hit the brace on the under side of the board.

If only one or more of the hammer heels strike, it may be best to pare off the top of the heel, sufficient to allow a space in which to work freely.

If the hammer stems, or any number of the hammer heels hit, it will be best to raise the sound-board by means of a brace. Judgment and ingenuity must decide upon the best kind of a brace, and the best place to to put it; but generally a straight wire rod, 3-16 of an inch in diameter, with sufficient length to screw into the bottom of the case an inch or more, and up through the sound-board, having a small nut on either side of board, to hold it firm, will be the best kind to use; and the best position for it will be where the break comes in the key frame at the over-strung bass. In all cases where the sound-board has fallen, so as to conflict with the action, it should be well braced to prevent further trouble.

Place the brace, if possible, so as not to conflict with the action; but it is often necessary to pare away the hammers and keys, to admit of their working freely.

Rattling of the *sound-board* is sometimes occasioned by the board having sprung up, and coming in contact, when vibrating, with the hitch pins in the iron plate, they having been driven too far through.

If possible to find the troublesome pin, draw it up: if not, spring the board from the under side, sufficient to cause the pin to make a depression in the board deep enough to allow the board to vibrate, without again coming in contact with the pin.

Again, the board sometimes rattles against the nose bolt which runs from the block, or bracing, below, through a hole in the board, and into the plate above. In this case, cut away the board from around the nose bolt.

HAMMERS BLOCK

When the jack remains under the hammer heel. This may be caused, 1st by the wearing away of the cushion, belonging to the regulating button; or 2nd by its displacement; 3rd by the displacement of the button itself; 4th by the springing or giving away of the regulating rail; 5th by the wearing out of the hammer heel cushion, which allows the jack to fall so far under the hammer as to prevent the regulating button throwing it off; 6th where the regulating screw is of iron wire, without a button, and the elbow of the jack is covered with leather, the latter may be so worn as to cause this defect, and in some cases, make the touch of the key extremely hard. The proper remedy will suggest itself for all the above.

Regulate the *jacks* to carry the hammers; from the bass end, up to middle C; to within 1-4 of an inch of the string, and graduate to 1-8 of an inch, from middle C, to extreme treble. If regulated too close, stems or strings are liable to be broken in heavy playing.

When there is any obstruction between the under side of the elbow of the jack, and the rocker. Remove it.

WHEN THE HAMMERS TOUCH THE WRONG STRINGS

Consider first whether the action is in its proper place; if so, alter the position of the hammers by the screws in the flanges. If the hammer head is too broad, shape it as already directed for sticking hammers, being sure, however, that the fault is not in the strings, or bridge pins.

When a majority of the hammers strike the strings in a wrong position, the key frame can be moved accordingly, but not so far as to throw keys out of position for damper wires. Look first carefully at the back bridge, if made of wood, as it may have pulled up from the block, and this would alter the position of all the strings. It is not uncommon, even among the best makes of square pianos, for the pins in the back bridge to sometimes give way in the wood, sufficient to alter position of strings; and frequently cases wind, so as to alter position of strings, to such an extent as necessitates spacing of hammers anew.

With too many tuners the "slicing process" is resorted to, on all occasions of interfering hammers, when it is very rare indeed that the hammers require any reduction in size; they certainly went right at first, and will go again, if properly adjusted.

DAMPERS RATTLE

When the bushing is worn, or eaten out, or hardened. To put in new, remove the damper wires, laying them where they will be undisturbed, that they may be replaced exactly as they were taken out. Next, cut a strip of new cloth, wide enough to exactly line the damper wire hole, or socket.

Point one end of the cloth, pass it down between the strings, into the socket, with a pointed wire, and draw it through, until the other end of the cloth is even with the top of the strings, and cut off at the under side of the pin block.

When the damper wire is too close to the string. Bend wire carefully to one side, as required, if fault is in the wire. Fault may be in the back bridge pins, more especially if back bridge is made of wood.

If pins are out of position, through giving away of the wood, or through pull of the strings, or if back bridge has become unglued and pulled up from the wrest block, replace pins as follows: a light blow, with a hammer and set punch, will replace pins if only slightly out of position; if much out, plug holes, and bore new: if back bridge has become loosened from block, slack up the strings until bridge can be forced into position: fit one or more flat head screws to hold firmly, reglue, and screw to close joint.

It may be found necessary to entirely remove strings, and back bridge, in order to clean latter and wrest pin block of old glue, before bridge will go back to right position. It will save time, however, to do this, as the position and direction of strings are changed, so long as bridge is not exactly right, and not only damper wires, but hammers will be affected by it.

When the lower button of the damper wire rattles on the strings. Prick up or renew the cloth. Same remedy for cloth of upper button, when it clicks against the damper lever.

When damper leads are loose. Hammer tight.

When damper lever flange is loose.

When the damper levers rub, or rattle, against the damper shade stanchions. Bend the stanchions to one side, or move the lever as required, whichever may be at fault.

When the shade buttons are loose.

When the strings rattle against the shade stanchions.

When the thumb screw in damper post is loose.

DEFECTIVE DAMPING.

When wooden back bridge has become unglued and pulled up from wrest pin block, the damper wires will be cramped, often so much so, as to prevent key being pressed down; remedy given under "Dampers Rattle."

Defective damping occurs when the damper felt is too hard, or has become moth eaten.

When the strings are not of the same height under the damper.

When strings are of different thickness. Damper felt may not bear equally on the strings.

When damper felt touches a string of the next note.

When the damper wire sticks in the socket hole. Heat damper wire with a match, and burn out cloth; unless fault should be in a rusty wire, or foreign substance in hole.

When the damper lever sticks on the felt of top button; black lead the under side of the damper lever. If a damper wire be broken, replace it with a new one: if a new one cannot be obtained, take the wire from the upper damper, which can be spared. Secure upper damper to prevent it dropping onto string, and muffling tone.

When the pedal rod is too long, or too short. Any fault in the trap action will show itself there and suggest its own proper remedy.

When the damper post screw is loose, or out.

When the pin in brace end of damper rail has dropped out.

When the back edge of damper rail is higher than the top of damper wire button.

When one damper felt, or head, touches another. This often happens when damper lever is warped, or lever may be broken at the flange, or flange may be loose on the rail.

When damper lever touches shade stanchion. If damper shade sets too low over the levers, it will prevent them from raising. This will also affect the touch of the piano, causing the action to block.

CHAPTER IV.

STRINGS RATTLE

When the damper wires are too close. (See "Defective Damping.")

When they touch each other, outside the bridges, at dead ends. What is called the dead end of the string is from the hitch, or plate pin, to the sound-board bridges; and from the back bridge, or agraffes, to the wrest pins. Through the strings, between these points, is woven a worsted braid, to separate the strings, and prevent rattle.

When the string touches a wrest pin.

When they are not firm on the bridges; or when the pins may be displaced through pull of the strings, or giving way of the back bridge, particularly if the latter is made of wood. Introduce larger pins, or set the old pins lightly down, with a hammer and punch.

When any metallic substance, on or about the piano, is loose.

When the string itself is defective. See "Strings Break."

When any hard substance is on the sound-board; it may be removed by passing a goose quill, thin piece of wood, or whalebone, under the strings, iron plate, and front brace.

When the short or bass string bridge is split, where pins are driven in; or when bridge is loose on sound-board; or when sound-board is cracked, or unglued.

When bridge is split, pins can sometimes be set over into solid wood; or a saw can be run through the split to make a clean cut, into which glue solidly a wedge of hard wood, and re-pin.

When board is cracked it is a difficult matter to repair, especially if crack extends under the iron plate. Sometimes a saw can be run through crack from the under side of sound-board; but to do a neat and thorough job, the strings and iron plate must be removed. The rattle can be stopped, temporarily, by gluing wedges into the split.

When the over winding on bass string is loose. Turn back the string sufficient to remove from hitch pin, and twist the string three or four times around, in the direction of the winding of the string, to tighten the winding; or rub the wire lengthwise with leather; or lightly hammer the over winding at the end. The surest remedy is, however, a new string.

When the castors are not all firm on the floor. Lower the castor on what appears to be the shortest leg, or corner of piano, by the use of pasteboard, or leather washers.

When any hard, detached substance touches the piano.

When a hinge, or any of the hinge screws, or hinge pins, are loose.

When a string is unsound. Rub it briskly with leather; or replace with a new one.

When a damper felt is hard. Prick it soft with needles.

When a bridge pin is loose. Introduce a larger pin.

When string has not sufficient side bearing, through too soft wood; or split in the bridge, allowing pins to fall away from string. Sometimes a second pin, set farther in the bridge, will relieve some of the strain on misplaced pins.

When one string is thinner than another.

When a wire touches the break of the treble bridge.

When the bass notes are of a dull, heavy tone, it is sometimes owing to the accumulation of dust and rust. Oil spilled upon them will produce this effect: as also when the elasticity of the string is gone. New strings are the only remedy.

Loss of *tone* in the bass strings, and rattle, is also frequently caused by the sinking of the sound-board and bridges.

When a string touches the next bridge pin, or a wrest pin.

When the belly bridge, or any of the sound-board braces, or buttons, are loose.

When a damper wire is too close to a string.

When strings touch one another at the dead ends.

When a string rattles in the agraffe. Flatten the string, and retune it; if this does not stop the rattle, sharping the string will sometimes do so. Often a size smaller, or a size larger string will stop the rattle. And not infrequently the rattle will resist all attempts to remedy it, short of a new agraffe. The steel string cuts into the softer metal of the agraffe, and vibrates against it, causing the peculiarly piercing rattle, or jingle, which is so apparent to all ears. (See "Breaking Strings.")

STRINGS BREAK

When wire is of uneven temper; too brittle.

When wire has been kinked in stringing.

When wire is defective through flaw in the metal.

When wire is of too large size to draw up to pitch or note desired; or when wire is too small to stand the pull, or to stand blow of hammer.

When wire has too sharp a turn at plate pin.

When there is too great friction of wire in agraffe, or under bearing bar. This fault is oftenest found in agraffes having too abrupt bearing, or sharp angles, where the friction is sometimes so great as to make it impossible to equalize the tension of the string, and the string breaks between the wrest pin and the back side of agraffe, without having the pitch of string, between the bridges, raised any whatever.

When elasticity is gone from wire.

When wire is rusty.

When a wire has been nicked by a file used in smoothing off top of bridge pins; or by any other tool falling upon strings.

When string hole in wrest pin has too sharp an edge, not having been counter sunk.

When one string alone receives full blow of hammer.

When hammer blocks against string.

When piano is played hard with soft pedal on.

Defective Wrest Pins.

When the wrest pin starts, or jumps. This occurs when the string has been wound on the pin with damp fingers. Chalk, powdered rosin, or shellac, dusted in the hole, will remedy this defect.

When wrest pin is too small for the hole. If driving does not remedy, or pin cannot be driven farther because of string touching iron plate, or pin block; turn out the pin, and line the hole with sand-paper, putting the sanded side against the wood; or line the hole with thin veneer. If pin block is split, no permanent remedy can be had, other than to thoroughly repair, or renew, the block; for larger pins, or lining of the hole, only tend to aggravate the difficulty. A new block would be such an expense, that a piano must be a good one in all other respects, to warrant the outlay.

Wrest pins jump from the effects of oil which has run into the block, around the pins, when applied to the latter, to remove rust. There is no way of ruining a piano so quickly, or thoroughly, as by the careless use of oil on the tuning pins. If pins are rusty, wring out a cloth in kerosene oil, and wipe them carefully, being sure no oil runs down pin.

A pin is *defective* when it has been twisted, or bent, at the string hole: for this, substitute a new pin.

When the corners of a wrest pin have been rounded by ill fitting tuning-hammers. In some cases the corners have become rounded so as to make it difficult to turn out the pin, until it has been filed square again. Frequently a wrest pin is driven so tight into the block that any attempt to turn it results in the pin being twisted off at the string hole. To remove the pin: carefully file it square again, and on to this, place an old tuning-hammer, or other piece of metal of like shape, heated very hot: allow this to remain until the pin is thoroughly heated, and has expanded the hole in pin block; then cool the pin as rapidly as possible, by applying the tuning-hammer, or other piece of metal, as cold as can be made, which will contract the pin, and admit of its being easily turned out. This method of removing broken pins is much superior to that of boring through the bottom of case and pin block, to drive the pin out.

The author has devised a tool for turning out broken, or rounded pins, which has never failed yet to remove them.

It is an ordinary T hammer, with the pin hole in stem of same, smaller than ordinary wrest pins; and in this stem is cut a left handed screw, which, by turning on to pin, cuts its own thread, and the tapering of hole in stem gives it, after a few turns, such a grip as will turn out the broken pin.

When a wrest-pin being too close to another; too close to the treble braces in iron plate; or too close to rim of case, will not admit tuning-hammer. This is more properly a fault in the scale, or proper disposition of the pins, than of the pin itself; or it may be, the pin hole was not bored straight, thus causing the pin to tip.

Sufficient wood can be removed from the rim, and sufficient metal from the brace in plate, to admit tuning-hammer, but it is a much more serious matter where one pin is too close to another. If there is sufficient room at any point beyond present line of holes, and within line of draught of string, where a new hole can be bored, one of the pins may be set back.

A tuning-hammer with a small shank, or stem, is a prime requisite in a tuner's kit, and may often save the trouble of moving pins, or cutting away case or braces.

DEFECTS WHICH PREVENT PIANOS FROM KEEPING IN TUNE.

When the bottom, or case, of square piano is too weak; when not sufficiently braced: case will pull or wind, and so break iron plate.

Plate breaks at weakest place in the back, where there is least iron, or most pin and screw holes drilled: usually at or near the break in scale, where over stringing begins.

When square piano has three strings in upper notes, the weakest point is likely to be in, or near, the treble brace of iron plate. Sometimes a piano does not seem to be effected by having a broken plate, but usually a new plate is the only recourse, and this can best be replaced at factory where piano was made.

When the wrest pin is defective in any way, or loose in the block. See "Defective Wrest Pins."

When the first coil of wire is not wound close to the pin at the string hole. Press the wire snugly up to pin.

When the wire is defective; or when tuner has bent pin.

When bridge, or plate pins do not hold. Any defect of strings, bridges, pins, winding of wire, lapping of strings, falling of sound-board, blocking of hammers etc., already enumerated under appropriate heads, would cause the piano to get out of tune, and prevent its being put in tune, so long as these defects were not remedied first. To above defects, may be added the ill effects of extreme, or sudden changes of temperature, excessive dampness, and the inexperienced tuner.

How to Order Bass Strings.

When ordering bass strings, either send the entire old strings as samples, or state of each string the following dimensions, viz :—

1 Length from hitch pin (plate pin) to commencement of winding.

2 Length of winding or wrapping.

3 Length from end of winding to tuning pin.

4 Thickness of the overspun, or wrapped part, by short sample or diagram, or by gauge of both centre and wrapping string, or by simple measure. To make quite sure, name the note and state presumptive age of instrument.

When a whole set, or continuous series, of bass strings is ordered, it is sufficient to give the thickness of the two extreme strings; but the respective lengths, as above, must always be given of each string. In forwarding to maker, always enclose address of sender, with the strings, and send order for same separately.

CHAPTER V.

Defects in the Pedal and Trap Action.

When the pedal foot sticks in the pedal, or lyre.

When the pin on which the pedal foot turns, squeaks in the pedal; never oil. Take out the pin, clean if rusty, and smear thoroughly with common hard soap. Rub the soap well over the surface of the pedal, where pedal foot works. Use this soap, with the addition of plumbago, if desired, for all frictional surfaces of trap action.

When the pedal stick is too short to raise the dampers, renew the worn leather, where required. See that pedal is screwed firmly to bottom of case, otherwise sticks would appear short, when really the fault is in the pedal being loose. Insert larger, but not longer, screws in pedal, if required to hold it firm to bottom of piano; or plug holes and re-bore.

When pedal stick is too long, it may prevent the dampers from resting upon the strings.

Sometimes the roller board of the trap action, twists or winds, throwing the elbow up or down as the case may be, and this would cause the pedal sticks to appear too short or too long.

It is quite sure that the pedal sticks have neither shortened or lengthened, and the fault should be found, rather than to increase or diminish the length of the stick.

When the pedal foot is too close to the floor.

When any of the pedal springs are broken, or displaced.

When any of the trap work studs, plugs, or elbows, have become unglued, or split.

Where metal pedal sticks are used, the leather cushions on pedal feet, and trap action above, rapidly wear away requiring new leather.

Proper Use of Pedals.

To the former use of the Cabinet Organ, by pupils, must be attributed much of the bad pedaling on pianos. So accustomed have players become to pumping the organ pedals, that they keep it up when playing the piano, and the result is a complete jumble of sounds. Few even of advanced musicians understand the correct use of the pedal, and the prevailing editions of music are, as a rule, inartistically and imperfectly edited in several important respects. The phrasing and dynamic marks are generally imperfect and very incomplete; while the ambiguous method prevalent of pedal marking, is ordinarily false, and thoroughly misleading. The signs "Ped." and ✻, generally occupy too much space on the paper, and ordinarily lead one to putting the pedal down, *before* or *with* a measure, or chord, when more often it should be done just *after* playing, and at a time of its own, independently of the music and accents.

The same ambiguous, or misleading ✻ mark often leads to a premature, or a late, lifting of the pedal. One must study harmony and rhythm, and form acute listening habits, to learn the first principles of its proper use.

It can be used more freely with high notes, than with bass notes: better with chords and arpeggios, than with scale passages.

For ordinary singing effects, one should *lift* the pedal *at the sound* of each new note of melody or harmony, letting it fall soon afterward. An excessive use of the pedal has much to do with pianos getting out of tune, and its correct use has been considered a matter of such importance, that the celebrated pianist, William H. Sherwood, has devoted much study and labor in the preparation of a book treating upon this subject.

Players would injure the piano less, if they would strike the keys with less force, and depend more upon a judicious use of the loud pedal. A better quality of tone, and one equally as full, would be secured.

Fewer strings would be broken, less trouble would be had with the action, and one great cause of the piano not standing in tune would be removed.

The evenness of the piano, both in tone and action, can be preserved, by using all parts of the key-board alike.

Five finger exercises, and such exercises as require a repetition of a few notes in succession, should not be practised on the same notes all the time.

DEFECTS IN LEGS.

When castor is broken, or screws are loose in castor.

When leg is loose in piano, or when leg turns too far around, either the wooden screw is loose in the legs, or threads have been broken from screw.

When iron plates are used, the plate may be broken, or screws pulled out, the latter usually from the leg. Not infrequently the case winds, through the pull of the strings, sufficient to cause the right hand front corner of the piano to be higher than the other corners, thus making this leg appear short, and leaving castor up from floor.

Remedy as directed for rattling castor.

To Find a Rattle in a Piano.

If in the action, it will be heard there, and can be remedied according to directions on action.

If the rattle is heard when any, or all, of the keys are struck, it is most likely the cause will be found on the sound-board, only excepting causes outside of piano, or some loose metal, or other hard substance, on the case.

The causes of rattle may be: *Hard* substances on sound-board (pins, glass, nut-shells, pencils, or keys, are most commonly found); *A cracked* sound-board; a *defective long bridge, or string; loose buff stop swings;* or *soft pedal lying* flat on sound-board, the leather cushions having come unglued; *loose castor;* the piano not setting level on the floor; or in the glue, which holds the sound-board in the case, having contracted from the board, remains on the case, near enough to come in contact with the board when the latter is vibrating; or partly detached glue on the ribs of sound-board; or the *bridge of bass* notes may be loose.

In above cases and also for cracked sound-board, a temporary expedient is to restrain the vibrating board, by the placing of a wooden, cork, or rubber, wedge between the sound-board and iron plate, or between the sound-board and front brace, at such point as a pressure on the board shows to be the most effective in stopping the rattle.

This is recommended to be done only as an expedient, when one has not the time or tools to fix properly; which would be to find, and remove the cause of the rattle.

Look well to the hinges, lock, front rail brace, soft pedal bar, or swings; for these are most likely to be at fault.

The sympathetic character of the piano, frequently makes it difficult to locate a rattle, or determine its cause.

A systematic course to be pursued is the quickest way however, and if one begins at the castors, then pedal, and works up through the piano, success will soon reward their efforts.

Experienced ears can locate the cause, by the character of the sound, in most cases.

If fault is not in castors, pedal feet, rods, or trap action, look to hinges. If hinge wires are not in firm, bend or curve them, so as to require force to replace them, thus binding hinge firmly together, and fastening the wire.

Next look to wire handle in action frame; key strip; damper shade buttons; top damper post and screw; prop-sticks to top; moulding over iron plate, around inside of rim of case; also moulding outside, if any; music rack; and iron plate on front brace.

If latter vibrates against plate, tighten screws in brace, or fix solid with wooden wedges.

When sound-board sinks, especially at point under short bridges of overstrung bass, the wires rattle against the bridge; and if bridge is loose on board, that also will rattle.

If rattle is outside of piano, and is caused by sympathetic vibrations, it can be detected, through the fact that such rattles usually respond only to one note, or octaves of that note.

Cracked window pane, mirror, or picture glass; glass shade, or ornaments on gas fixtures, or lamps; door key; and other metallic substances.

Finding the offending cause will determine the remedy required. In all cases find out what *is* the cause, before attempting to remedy any defects in the piano.

CHAPTER VI.

UPRIGHT OR CABINET GRAND PIANO.

THIS form of construction, doubtless first devised by an American,* has certainly been more fully developed and perfected in this country, than in any other. The climatic changes here are so frequent, and severe, that solidity of construction was demanded of American makers, and to this was added a disposition to simplify the action, increase the amount, and perfect the quality of tone.

In the square piano action there are six working parts; key, jack, jack spring, hammer, damper lifter, and damper.

In the upright, ten; key, swing, lifter or sticker, rocker, jack, jack spring, hammer, hammer spring, damper, and damper spring, not counting back catch, stirrup wire and ribbon, or damper spoon; and some makes have still more parts: so it will be seen that the upright action is somewhat more complicated than that of the square.

There are, all told, many more parts, and without them it would be impossible to attain that superiority which the upright has over the square piano.

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*President Jefferson, in a letter written to his daughter at Monticello in 1800, writes as follows: "a poor, modest, but ingenious young man," in Philadelphia, "has invented one of the prettiest improvements in the forte piano I have ever seen. His strings are perpendicular, and he contrives, within that height, to give his strings the same length as in the grand forte piano." . . . This antedates, by four years, the claims of the Messrs. Broadwood for William Southwell, of their house; and also the claims of William Warnum.

In volume and quality of tone, and perfection of action, the upright nearest approaches the grand piano, and when, to this, is added its size, convenience of moving and beauty of style, there can be but one opinion; the upright has "come to stay."

With the increased number of parts, has come an increased liability to get out of order; and to meet this liability, manufacturers demand better material, exact more skilful labor, and expend more thought, time, and money, in its construction.

That the construction and care of uprights may be better understood by tuners, and dealers, and the piano more carefully used by purchasers, is one of the aims of this work.

Most tuners have some musical ability, in fact, having a musical ear led them to choose this as a profession, and having musical ability, they lack mechanical, for not often does the same person possess both in the same degree.

And it is also true, that not all have had the advantage of factory training, where, while learning to tune, they could also become familiar with the action, its construction, regulation, and how best to repair it, when required. To aid in raising the standard of work outside of the factory, to keep pace with the progress of those who make the piano; to enable dealers to be better judges of what constitutes a good piano, and what to require of the tuner; and to more fully instruct the public in general, upon the worth, use, and protection, of this most popular of all musical instruments, is an object worthy of one's best efforts.

Tuning and regulating is more than manual labor, it is an art; and the public in general, and not a few dealers, have yet much to learn before they can fully appreciate the perfected piano of to-day, its artistic tempering and tuning, and delicate adjustment, by action and tone regulating.

In the construction of a piano, the first and most important step is "drafting the scale;" in other words, planning the piano, as a house is planned, only the estimates for measurements in a piano are figured to the minutest fraction, and from the draft, or drawing, the wooden pattern is made, from which is cast the iron plate.

Accurate allowance for the shrinkage of cast iron, in cooling, must be made in the drafting of the scale, and making of the pattern, to the one-eighth of an inch to the foot, or the whole plan will be disproportioned, and faulty.

Careful estimates must be made, also, as to the exact amount of strength required in the iron plate, to bear its part of the strain of the strings, and no more weight of iron must be added, than is required for perfect security.

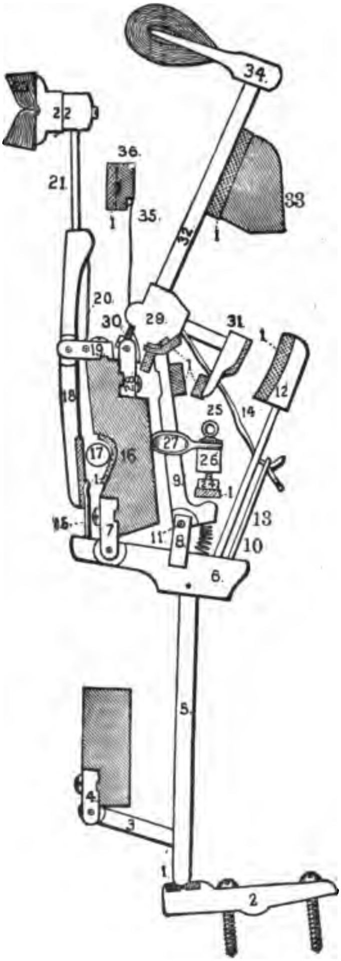
In the construction of the case, the same method of planning is followed, and not only must the case be drawn to the same scale, but the woods employed in its construction must be chosen with reference to their fitness to withstand the various strains: and even the position they assume, and the way their annular layers run, will determine their strength and utility.

The blocking of the piano must be of light woods, but such as will best resist all strains and compressions; and while iron frame and case are made with reference to their part in the production of tone, it is in the construction of the sound-board that the acme of knowledge, skill, and art is reached.

All the known varieties of wood have been tried, and spruce alone found to give the best results.

The time of felling the tree; cutting up; the length of weather and in-door seasoning; the number of pieces constituting the board; the direction of the grain; the amount of sap, or imprisoned amber, that the various parts shall contain; the number and direction of the bars or ribs; the compression of the fibres of the wood, through crowning of the board, or by the use of compression screws; the varying thickness of the board, and how best to confine it within the case; all these and many other points must be considered in the make up of the piano.

Not less care and mechanical knowledge is required in the construction and adjustment of the action which is drawn to the same scale, and the present standard of which is for weight of touch two and a quarter ounces, and five-sixteenths of an inch for fall of key, or depth of touch.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ACTION OF UPRIGHT PIANOS.

1. Indicates the cloth, leather, or felt, upon which the various parts of the action rest or fall noiselessly.
2. Key Rocker, with screws.
3. Swing.
4. Swing Flange, screwed to lower Flange Rail.
5. Lifter.
6. Jack Rocker.
7. Rocker Flange, screwed to Centre Rail.
8. Jack Flange, solid on Rocker.
9. Jack.
10. Jack Spring.
11. Centre Pin of Jack,
12. Back Catch on Back Catch Wire.
13. Stirrup, or Bridle Wire.
14. Bridle Ribbon.
15. Damper Lever Spoon, screwed into Key Rocker.
16. Centre Rail.
17. Damper Lever Roller.
18. Damper Lever.
19. Damper Lever Flange, screwed to Centre Rail.
20. Damper Lever Spring.
21. Damper Extension Wire.
22. Damper Head, secured to wire by set screw.
23. Damper Felt.
24. Regulating Button.
25. Regulating Screw.
26. Regulating Rail.
27. Regulating Rail Support, metal, screwed solid in Centre Rail.
28. Hammer Flange, screwed to Centre Rail.
29. Hammer Heel, turning on Centre Pin in Hammer Flange.
30. Metal Clip, securing Hammer Heel to Centre Pin.
31. Back Check.
32. Hammer Stem.
33. Stem Rail.
34. Hammer.
35. Hammer Spring.
36. Upper or Hammer Spring Rail.

All holes in which Centre Pins turn are bushed, or lined, with cloth.

To Remove Upright Action.

Turn off button, or head, from bracket bolts; disconnect or remove, if required, soft pedal stick; grasp action at two centre brackets, with thumbs over stem rail, tip forward from bolts and lift out.

In some makes, bottom of sticker is split, bushed, and fits over pin in rocker on key, and must be pulled out first: in other makes, bottom of sticker has cloth glued on, with projecting edge, over which a metal clip, or flange, on rocker, is fastened by screw. Loosen screw, and disengage cloth.

Some makes have, on bottom end of sticker, a projecting pin which rests in hole in rocker, or in key; other and better makes have a regulating button, on top of wire, which screws fast into key.

Some actions have both ends of sticker fastened to a swing; and, in this case, action separates at upper swing rail.

CHAPTER VII.

DEFECTS IN UPRIGHT PIANO ACTIONS, AND HOW TO REMEDY.

KEYS STICK AND RATTLE.

KEYS in uprights are subject to nearly the same defects as in square pianos, and can be remedied same way.

In some makes, keys will be leaded to fall in front, when action is removed: others are loaded heaviest back of centre rail. Note this before attempting to free a supposed sticking key, when same remains down because so weighted and intended.

When key sticks, begin at front end and work back, to find cause, unless cause should be at once apparent elsewhere. Frequently the guide pin hole is too short, and pin strikes on either end of mortised hole, leaving a mark where it strikes.

Look for this before widening hole, or turning pin to free key, and be sure the fault is not here.

Bushing in guide pin hole of black keys frequently scrapes, or rubs, against next key. This happens when end of cloth has come loose from key, and, having glue on it, makes a very perceptible scraping.

Frequently a splinter on side of key, and sometimes the side of black key, at bushing hole, splits off and rubs against next key. To remedy; re-glue, and, if the break is large enough to weaken hole, it will be best to brad the splintered piece to key.

If key is made with a harder piece of wood set in at centre pin, this will sometimes snap. To detect; spring key in the hands, and, if found to be loose, turn a three-quarter inch screw, small wire, into each end of piece, countersinking for screw head, that piece may not be split.

HAMMERS BLOCK

When regulating button is not turned low enough to throw jack from under hammer heel. This may be when cloth cushion on regulating button has become pounded down, worn, or displaced.

Or when regulating rail has split, allowing regulating screws to slip up; or when rail is too light, and springs, not having supports enough to hold it stiff; or when regulating button is split, and loose on screw.

Hammers block oftenest from what is called "*crowding up*" of the back catch. This is caused partly by the springing of back catch wire, and partly from the beating down, or compression, of the cloth, leather, and felt cushions throughout the action, which admits of the back catch crowding against the back check, and forcing hammer against string.

When hammer blocks this is the first thing to look to, especially in new pianos.

Back catch should be just far enough from back check as not to touch latter, until after fall of hammer from the string; and yet close enough to not only prevent rebounding of hammer, but support the hammer, keeping the heel raised to admit the falling under of jack, to insure rapidity of execution.

The blocking of hammer, from crowding up of back catch, is often supposed by tuners, to be caused by jack being too far under heel of hammer, and then regulating screw is turned so far down as to throw jack nearly out from under hammer heel, the result being entire loss of power in touch, for when key is depressed, jack is thrown forward without raising hammer.

In regulating back catch, or stirrup wires, leave them in a uniform line.

Hammers block, when leather on heel is worn through, and jack catches on same. Renew leather.

When felt cushion on hammer heel is worn by jack. Renew felt, and black lead jack, if needed, which will most likely be found to be rough.

In some makes, the inclination of jack is such as to cause it to wear out the felt cushion on hammer heel, the tendency being to work against the felt more than the leather on hammer heel.

This is a defect in construction, or assembling, of action, one not easy to overcome, and never occurring in first class makes. To remedy requires an entire new disposition of the rails, on which are screwed the flanges; throwing the hammer heel slightly forward, or the rocker back, or moving both.

As this will necessitate a change in dampers, and all other parts of action, only those should attempt it, who have had experience in setting up actions. Sometimes the hammer heel will admit of a thicker felt being used, and this will throw jack forward. Care must be taken that jack is not thrown so far forward as to slip from under hammer heel without first throwing hammer forward full stroke.

HAMMERS STICK

When the pin is too tight in flange. Wet the bushing, on both sides of flange, with a drop of refined kerosene oil, or with alcohol.

When the pivot pin has worked to one side. Replace it, and tap both ends with a light hammer.

When the hammer stem has twisted, causing hammers to interfere with one another, with action brackets, dampers or stem rail swings. To remedy; twist the hammer head in opposite direction, and burn stem, by holding a lighted match on side of stem desired to be drawn.

To avoid smoking the hammer, let match burn clear before applying to stem. In factories, burning tongs and lamps are used for this purpose, but the match will be found to answer the same purpose.

When the hammers in bass interfere through being too close, and having to pass one another at an angle. If there is not sufficient room to properly space all the hammers, then they must be shaved. Generally a judicious paring off of the right hand lower, and left hand upper side of hammer, will give all the space needed.

Hammers stick when the hammer spring has slipped out of the groove and rubs against the stem: replace spring.

HAMMERS RATTLE, SNAP, OR CLICK,

When the metal flange is loose on hammer heel. Screw tight. Inexperienced persons sometimes loosen this flange screw when hammer sticks, thinking this the way to relieve the tightness. This metal flange should always be tight, to hold pivot pin firm in hammer heel.

When hammer stem is spalled, or cracked. Glue stem if it can be made perfectly solid thereby; or put in new stem.

When hammer is loose on stem. Often a click like the snapping of one's thumb nails together, will be heard, and seemingly defy all efforts to find the cause. Sometimes it will be necessary to twist the hammer repeatedly one fourth way round before it will give way, and can be removed. In setting up action in factory, little or none of the glue on stem went into hole in hammer, and that on stem, in time, dries and pulls away from hammer, leaving stem to snap. This same fault occurs often in gluing stem into hammer heel.

In twisting to find where loose, hold the heel of hammer firmly in one hand, while twisting hammer with the other hand, turning to right and left. This twisting will often disclose split in stems that appear sound, when they are really the cause of snapping noise.

A shaky hammer head will often cause a clicking sound.

Hammers rattle, or snap, when cloth cushion in groove on hammer heel has become worn through, or displaced, and spring strikes against the wood. Renew or replace cloth. A clicking or scraping sound will be heard when hammer spring is displaced and rubs against stem. Replace spring in groove of hammer heel.

When lower end of hammer spring strikes top of metal flange.

HAMMERS STRIKE THE WRONG STRINGS, OR STRIKE UNEVENLY,

When stems twist, and turn hammer head; remedy as directed for twisting stems. *When* hammer heel flange is loose, or when metal clip is loose on hammer heel, or when hammer heel is split at pin hole, hammer will strike the strings unevenly, or fail to strike all the strings.

When stem is too light, hammer will strike unevenly when key is struck hard.

The tone of extreme upper notes is sometimes affected by alteration of position of hammer, due to change in stems, causing hammer to strike too close to bridge (sometimes on top), or too far below bridge.

Remedy by burning, same as for twisting stems, raising or depressing head of hammer, and holding in desired position while burning the stem. Allow for a slight continued drawing of heated stem, after match is removed, or hammer will be altered too much.

Hammers click when felt head is loose on hammer, especially where under felt is used, and hammer is not wired. In regluing, use umbrella rings to hold felt; or wind firmly with strong string. After glue has set, remove rings, or string, and smooth up felt with a sand file. (See file in Rep. Dept.) If felt has become detached from both sides of many of the hammers, it may be found best to substitute new hammers, especially if piano is a good one, and otherwise uninjured by dampness.

Hammers click when the strings have cut ridges into the felt, and hammer has become displaced, so that string strikes to one side, and slips into the ridge, making a click or snap, of such a character as to mislead one into thinking it caused by contact of wood, or metallic substances. To remedy; point the hammer head by use of sand file, beginning well down on the sides, and file felt to a well-rounded point, working from either side to head, and going deep enough to take out the ridges, unless ridges should go through felt, in which case it may be best to re-cover hammer, or put on new hammer. Always file felt with reference to its grain. For hammers of upper notes, a better tone is obtained if felt is cut to shape, and not filed. Use a thin-bladed knife (felt if obtainable) and keep it sharp, by use of emery hone. (See Hone in Rep. Dept.)

Hammers snap or *click* when the heel is split where brass pivot pin runs through. This defect is easily caused by hammer stem being bent too far to either side, splitting hammer heel; if properly glued, it can be made strong as ever; but in most cases, a new heel is the surest remedy.

Hammers click when glue which has run down side of heel, from stem, draws away and is loose on heel, but fast around stem.

HAMMER FLANGES

Rattle when loose on flange rail.

When split at screw hole, or when screw is broken, or washer loose under screw head.

ROCKER AND DAMPER FLANGES

alike, rattle from same causes. Remedies same.

Rockers work sluggishly when tight at the pin on which they turn. Remedy with oil, or alcohol, as directed for sticking hammers. *All bushed joints* throughout the action, when too tight, should be relieved with oil, or alcohol, on pivot pin.

A medicine dropper, with long point and small hole, will be found the best for this purpose, although a straw or pencil point, will answer where the part can be easily reached.

Rockers Rattle when rocker flange is loose on rail, or when flange is split, or bushing worn out, or displaced; also when rocker is split where pin runs through, or when pin has worked to either side.

When jack flange has come unglued from rocker, or is split through centre, or through pin holes.

When rocker is split at sticker or lifter mortise.

When pin has worked out of rocker, at upper end of lifter, or when bushing is worn, or displaced in rocker.

When there is any defect in back catch, or stirrup wire (which see).

When jack spring is loose in rocker, or any of the glue around jack spring is loose.

Rockers stick from above causes, and also when pins are too tight in bushings. Remedy with oil, or alcohol.

Rockers stick when spoon is too short for damper. (See " Dampers Sticking ".)

When stirrup wire interferes with back catch wire of next key.

When stirrup wire is bent so far forward as to pull check ribbon tight, thus preventing jack from falling under hammer heel.

When there is any obstruction between the rockers, or rocker tight on pivot pin.

Damper levers stick on flange pin when too tight. Remedy as directed.

Damper levers rattle when split either at pin, on which they turn, or end into which extension wire is screwed.

Dampers rattle when head is loose on the extension wire: tighten set screw, unless damper head should already be split, from set screw having been turned too tight. This often happens, as grain of wood in damper head runs across same. To remedy; reglue.

Dampers rattle, when felt is loose on cushion, or cushion loose on damper head. Reglue.

Dampers rattle when they strike one another, strike the spring rail, back, or the action brackets. Remedy suggests itself. In some cases, damper head slips down on extension wire of damper next to first string in over strung bass, causing a sticking of damper, and rattle of bass note. Frequently the top of damper strikes under side of hammer, when latter is thrown forward. This is caused partly by felt of damper flattening out in use, and extending, but more by *flattening* of *hammer* at point, and spreading out of same on sides, causing the two to interfere. This is of frequent occurrence in damp climates, where the felt becomes pliable through excessive moisture.

Lower dampers on wire, and if hammers are badly flattened (not cut by strings), shape them over, as directed in sticking hammers.

Dampers rattle when too light to stop vibration of strings, and when glue, or hard substance, is on felt, or when damper felt is hard from rust off from the strings.

DAMPERS STICK

When they rub together, or against action brackets, or other obstructions, or when pivot pin works out to either side. Remedy as required.

Dampers stick when felt becomes attached to strings through rust. This will also cause a muffling of tone.

When too tight on pivot pin.

Dampers stick when spoon in rocker is so short as to work under end of damper lever, and catch. This is a defect in construction, and best remedied by substituting longer spoons.

To lengthen by turning out those already in piano, will leave them loose, and liable to displacement; and to lengthen lower end of damper lever by extending cloth cushion, will be, at best, an unsatisfactory expedient.

In substituting the new spoons, leave a little play between end of spoon and lever, and have them high enough to avoid the trouble sought to be remedied, but not any higher than safety requires, as the higher the spoon works on lever, the harder will be the touch of piano.

Dampers stick when spring is broken, corroded, slipped out of groove, or bent out of shape.

When cloth cushion of groove is displaced.

Dampers often stick from same defects as cause them to rattle, and remedies required are same.

Dampers sometimes stick, and rattle, when crooked spoon turns in rocker.

When damper lever roller is loose; tighten screws that hold swings.

Defective damping will result from any of above causes, and also from a wrong position of dampers on the strings, which will produce harmonics or overtones. Where the scale is so drawn, that harmonics result from the damping, it is not possible to entirely overcome the defect by changing position of dampers. Sometimes the substitution of longer felt on damper will stop the harmonics; and on a few of the longer plain strings, an extension, or supplementary damper will aid much; but nothing can be done to entirely remedy a defect which is inherent in the plan and construction of piano.

JACKS RATTLE

When flange, in which they work, is split either through centre, or at pin holes: or when flange is loose on rocker.

When jack is split and loose on pin. Reglue in above cases.

When jack spring is loose in rocker. When glue, or other hard substance, adheres to felt cushion of hammer heel on which jack falls, or on leather heel of hammer.

When jack strikes regulating rail, from tipping too far forward. When bushing of jack flange is displaced.

When upper end of jack spring does not fit jack. (See "Jack Spring".)

When wire pivot pin is loose in jack. Usually a light blow with a small hammer, on either end of the pin, will bend it in the centre, sufficient to make it tight in the jack, and not alter materially the bearing of pin at ends.

If, however, a very slight upsetting does not tighten pin sufficiently, introduce a larger wire. If one cannot be readily obtained, draw out the pin, and flatten it slightly in centre, and return to jack, putting greatest width of flattened pin to run with grain of wood, as it will hold better.

One of the most perplexing rattles to find in a piano action, is this one caused by loose pivot pins.

The pin may be apparently tight in the wood, and yet snap at each movement.

This is a defect oftenest apparent in solid heel of hammer, and can be detected by its sound, which is like the snapping of a quill, or the finger nails.

Jacks scrape when black leaded end has become rough through dampness, and requires re-leading.

Jacks rattle through any defect of regulating button, screw, or rail (which see).

When rockers tip from any cause, jack flanges may interfere.

JACK SPRINGS RATTLE

When **loose in the rocker, or when any part of glue is loose.**

When one coil of wire in the spring slips over a lower coil, and strikes the glue, or the rocker.

When the wire catches on any roughness of countersink in jack, and slips off, or when wire gets to one side of point in countersink; or when spring gets out from under jack.

JACKS STICK

When too tight in bushing at pivot pin. Never work a jack sideways to loosen it: use kerosene oil or alcohol on the bushing.

Jacks stick when from any cause the jack spring fails to work.

Jacks fail to work properly when stirrup wire is bent so far forward as to tighten stirrup ribbon, thus preventing fall of rocker and jack, sufficient to allow jack to go under hammer heel. See "Defects of Back Catch and Stirrup Wires."

Jacks stick, or work sluggishly, when any obstruction has fallen between jack and flange.

When wire in flange has worked to one side, and rubs against next key, or when wire has been much bent.

DEFECTS OF BACK CATCH AND STIRRUP WIRES, RIBBONS AND TABS.

Back Catch wire sometimes turns, being loose in rocker; or back Catch turns on the wire, being loose. Fasten by gluing. Stirrup wire, if bent so far forward as to tighten ribbon, will prevent proper action of jack. See "Rockers Stick."

Stirrup Wire frequently gets bent sideways, and strikes back catch wire of next key; and frequently the leather tab, or point glued to end of ribbon, snaps on the wire. If stirrup wire is too close to back check wire, leather tab will rub against it, causing a scraping sound.

In regulating these wires, go over back catch first, then bend stirrup wires, to avoid contact of one with another, or the ribbon tab with back catch wire, and leave them all at a uniform height, and in a true line.

INJURIES CAUSED BY MICE.

Serious injury may be caused by mice eating off check ribbon and leather tabs. To properly repair is a somewhat expensive job, requiring the removal of back check stems, to insert ribbon in stem hole in hammer heel. This necessitates new stems, and to reglue them in hammers and checks, getting them of uniform length, and ribbons in even, will take considerable time, and much care.

Tack wire netting over Hand Holes in back of piano, and any other openings through which mice can get. The red cedar in pianos suffers from the ravages of mice, as do also felts and cloths, especially when mice nest under the keys.

Back Catch leather or felt, whichever used, sometimes comes unglued, and often wears out.

Frequently a scraping sound is heard, when back check falls upon back catch. This is caused by leather on back check being put on with grain running in opposite direction from grain of felt or leather on back catch. One way, the leather feels velvety and soft, the other way the points in the grain are apparent to the touch.

This difference of running of grain not only causes the scraping sound, but wears out the felt, and often keys will be found covered with felt, like powder, which has been worn off by friction against the leather.

DEFECTS IN STICKER AND SWINGS

Are caused by stickers splitting at pin holes in either end; or sticking at either end, bushing being too tight; or pins working out of either jack rocker, or rocker on key; or in bottom of sticker. Swings may also split and stick; and swing flanges are liable to same defects as other flanges.

DEFECTS IN ROCKERS.

Rockers rattle when loose on the key. Tighten by turning screws, and do so with reference to proper height of jack under hammer heel, as this is the way height of jack is regulated.

Rockers sometimes tip on key, and should be righted by veneer, or other thin piece of hard wood, placed under lower side of rocker. Pin in rocker sometimes works out, interfering with next key.

Bushing becomes worn or displaced, causing rattle, Renew. For description of rockers, see "How to Regulate."

DEFECTS OF REGULATING RAIL, SUPPORTS, SCREWS, BUTTONS AND CUSHIONS.

Rail may be too light in construction, or not have sufficient number of supports to hold it stiff. In this case rail will spring, and cause an unsatisfactory touch.

Rail may be loose on supports, and rattle, or change its position, and alter the fall of jacks.

Rail may be split, allowing regulating screws to be forced up. Fasten with small screws.

Regulating button may be split, or hole too large for screw; cushion may be worn through to hard glue; or cushion may be displaced. Screws, when corroded, or defective, twist off in the rail. If they turn hard, touch the screw with a drop of kerosene oil.

DEFECTS OF HAMMER OR STEM RAIL.

When felt between action bracket and hammer rail pounds down, shrinks, or becomes displaced, hammers will tip forward, preventing jack from falling under hammer heel.

Rail twists, or winds, throwing hammers toward strings, causing lost motion between top of jack and hammer heel, and consequent loss of stroke and tone. To even up rail, may require a planing off on inside, at one end, or the bringing of rail farther forward, if possible, and evening up again by layers of cloth under the felt. If rail continues to wind, it may be well to saw one or more times across the grain, part way into rail from back side, and glue into saw scarf, tightly fitting wedges, same as directed for warping keys in square pianos. The metal with which rails are covered may rattle, and require setting down along the edges to tighten.

Where hammer rail "swings," all enter action brackets from the same side, the rail may work to one side and swings come out of bracket, or so far out as to strike stems of hammers next to brackets. In this case reverse one of the swings, to enter from opposite side of bracket having most room between that and hammer stem.

When bushing is out of bracket, swing will rattle. Metal clip, in which works upper end of pedal rod, sometimes gets loose; or where pedal rod works directly on rail.

DEFECTS OF PEDAL ACTION

In upright pianos are very similar to those in squares.

Raw-hide buttons, or brass nuts, on wires connecting pedal feet to levers, sometimes work off; to prevent which, turn on a second one to make a lock nut. Trap pins work out, or squeak, and trap springs break, come loose or squeak. For squeaking of rubbing surfaces in trap action, use common yellow soap and black lead, which will be found better than oil. Trap plugs split at pin holes, or pull out of bottom of case. Levers frequently interfere, especially if plugs split or work loose, or pins become bent. Felt, or leather, on ends of levers may be displaced, or become hard.

DEFECTS OF PEDAL RODS.

Pin in lower end may be displaced, allowing rods to slip off lever: or if pin in top of soft pedal rod is displaced, it may fail to throw hammer rail forward.

Whenever top of loud pedal rod squeaks, in working against damper lever rod, use the soap and black lead. Rods frequently rattle when they touch any part of case or when loose in the levers.

If pedal feet go part way down, before operating action, take up the lost motion by turning the buttons, or nuts, on wires.

CHAPTER VIII.

UPRIGHT PIANOS RATTLE

When a castor is loose, piano not setting even on floor; or *when* pin is loose in hinge of top; or *wire netting* on back of case may be loose. *Pedal feet*, wires, or other part of pedal action may rattle.

Front of piano, under key board, may rattle in case against spring, or button, that confines it; or panel may be loose in the front, or moulding around panel may be loose; fall board may jar, key cheeks and key strip in front become loose; escutcheon rattle in key strip; or metal strip on finger slip, back of black keys, rattle.

Front of piano, if loose, will rattle; panels, or fretwork, rattle in front of piano; silk back of fretwork, will rattle, especially when any glue may be on silk, and not fast to back of panel; buttons, that hold front of piano in case, often rattle, if loose, and allow front to rattle; and every kind or form of music rack or desk made, with but one or two exceptions, will rattle, and most of them rattle badly at times, and some few rattle all the time. Look to the fastening, or catch, and to fretwork and silk lining.

The music rack that shall combine the desired requisites, is yet to be invented. Here is a chance for the inventive tuner.

The moulding around inside of case, and over iron plate and block, may be loose, and rattle; frequently this will rattle when apparently tight all round. Brad it, where required.

If buttons are loose on action bolts they will rattle: and damper lever roller rod rattles when loose: when any part of action is loose; or when pedal sticks may rest against any part of frame.

SOUND-BOARD rattles when loose in case; or when any of the ribs, bridges, or buttons are loose; or when any glue may be loose on either case, or board, and adhering to either one, rattles against the other.

When a board is split; or the board loose on studs, props, or supports; or when shavings, wood borings, or glue, have lodged against board at bottom of case.

Board rattles if brace, or ribs, in vibrating, touch blocking behind. Articles about the room rattle from sympathy, same as in square pianos (which see).

STRINGS RATTLE from very many of the same causes as in square pianos — which see — also from any unequal pressure on string, of bearing bar, or from lack of sufficient pressure, or because string has cut into bearing bar, or into bridge. To remedy; tighten bearing bar screws, nearest to rattling string.

Strings rattle at dead ends, if not separated by braid, or evenly spaced to run without touching. If string of one pin draws against another pin, or against action bracket bolt.

Sometimes a string gets kinked when put on, and, unless kink is removed by turning the string before being pulled up, it will make a false tone (beat like two strings out of tune); and if there are three strings to this note, the kinked string will be almost sure to rattle against one of the others.

A kink will never pull out of a string, and as it cannot be put in perfect unison, it will be found best to replace it with a perfect string. Some makes of pianos, through defect in drafting of scale, have many false strings, and for this defect there is no remedy, as fault is in the plan and construction of instrument.

Shavings, or borings of wood, which lodge on the long, or sound-board bridge, and lie between the beveled edge and strings, are frequently the cause of rattles, and so pronounced is this rattle that it is one of the easiest to remedy, as it locates the cause, and all that is required is to remove the obstruction.

If bottom front of piano is removed, the lower part of this bridge can be readily reached, also the bridge of bass strings.

First string in *over strung bass*, sometimes rattles when damper head of next key above has slipped down on damper wire and strikes string, and sometimes this string vibrates against action bracket bolt.

Bass strings rattle when covering, or over winding, is loose.

To remedy; let down string until it can be removed from hitch, or plate pin, then twist lower end of string, in the direction of over winding, two or three times, to tighten same, then replace on hitch pin, and tune.

When there is any defect in wire, strings rattle, and a new string is the only remedy.

Bass strings sometimes vibrate against the back edge of action bed; and the last string sometimes rattles against the brace of iron frame, where same runs too close, and in line with string.

CHAPTER IX.

TO REGULATE AN UPRIGHT ACTION.

REMOVE the action, as directed on page 46, then go carefully over the keys to see that none stick, or work sluggishly, on either guide or centre pins.

Should any keys stick, press back the bushing by carefully inserting pointed end of tuning-fork. There are key pliers made for this purpose, but a fork with tapered point will answer same purpose.

Be careful not to enlarge holes too much, or keys will tip on centre pin, and strike together in front. Guide pins in front rail should be oval, and keys can be regulated there by turning pins as required.

If holes are too wide, set them up with punch as directed for "Rattling Keys," page 18.

Next even up keys (if uneven), by paper punchings over the cloth ones. To do this well, especially if keys are beaten down through centre of key-board, a straight edge will be necessary to line the keys up to those in extreme bass and treble, making depth of touch through centre not more than five-sixteenths of an inch, running up to one-fourth of an inch in treble, and for extreme bass, a trifle deeper.

After a true line has been obtained with the punchings, then turn them so the cloth ones will be on top, and next to key, to prevent paper from scraping against adjoining key.

Next, see that keys are all perfect; ivory, ebony, and leads, tight; then put in action, and screw up firmly to action bolts. Next space the hammers (see "Defects of Scale"), so each shall strike the strings evenly, then space rockers in same manner, bringing top of jack directly under hammer heel.

If metal clips are used on hammer heel, see that they are all tight, and all flanges screwed firmly to flange rails.

There are, in general use, three methods of taking up lost motion.

The flat headed screw in key, under sticker, over which is placed felt cushion.

Rocker, which, as its name indicates, rocks on the key; and the *regulating button*, which works on an upright threaded wire, screwed into key.

In regulating by rocker, always turn both screws, to insure their being tight. If one is let up, turn the other down, or rocker will work loose and rattle.

As the position of hammer rail determines the relative elevation of the hammer heel, see that rail is in its place against action brackets, then proceed to take up lost motion, between top of jack and hammer heel, by turning regulating screw, or buttons, so jack will raise hammer at slightest depression of key, yet not be so close but that jack will fall under hammer heel, ready for another blow. To insure solid work, strike each key firmly, to settle all parts.

Next regulate back catch by bending wire so that it will receive fall of hammer, prevent its rebounding on rail, and aiding jack in falling into place.

If back catch is too close, it will block hammer (which see); and if too far away, jack will not fall so readily under hammer heel.

Stirrup wires should be so regulated as to avoid striking wire in next key, and prevent leather tab from rubbing on back catch wire.

Stirrup ribbon should be left slack, or action will not repeat.

Bend all wires in a uniform line.

Some actions have regulating screws in damper levers, with which to take up any wear of felt or cloth cushion on same, and to aid in closer adjustment of each damper lever.

Should it be necessary to alter position of spoons in levers, leave a little play between spoon and end of lever.

It is seldom necessary, however, to bend these spoons, or alter position of dampers on wire, excepting for causes already noted.

Next regulate fall of hammer from jack by turning regulating screw, so that hammer will be thrown forward to within three-sixteenths of an inch of the string, through centre of piano, graduating to about one-eighth of an inch in extreme treble, and one-fourth of an inch in bass.

It will be best not to regulate closer than this, to avoid any possibility of blocking.

The rapidity and ease of action will depend largely upon the accuracy with which jack and back catch are adjusted.

If jack is regulated as directed, and back catch so regulated as to longest sustain hammer (without being so close that back check, in its assent, will strike back catch, or the two crowd hammer onto string), the jack will practically remain under hammer heel, and the most rapid execution be made attainable.

Finally, go over action again and see that each screw, wire, and spring is in proper position, and all work quietly, and with least possible friction.

DEFECTS OF SCALE.

What constitutes "the scale" of a piano has already been noticed, but for convenience under this head will be included defects of pin block, pins, bridges or agraffs, strings (not elsewhere noted), sound-board bridges, and iron plates.

In the square and grand piano, and in bass of uprights, the strings are all held in position, at striking point of hammer, by bridge pins, or by running through agraffs: but in the upright, excepting in bass, the strings run direct from tuning pin over bridge; and unless the tuning pin is so set that string will draw in line from sound-board bridge pin to tuning pin, it will pound into line, and result either in a crowding, or separating, of strings: in the first case, the strings will rattle together, and in the latter case, one or more of strings may work so far to either side as to prevent contact with hammer.

Neither the downward pull of string, from bridge to tuning pin, or slight depressions filed in bridge, will hold the strings properly spaced if the tuning pin is not in line with sound-board bridge pin, and striking point of hammer on bridge.

In spacing hammers, first see that strings are all evenly disposed on bridge, and if any are too close, or otherwise out of position, it will be best to introduce between them a bridge pin, immediately back of bearing, on bridge; pin to be driven in even with top of string.

DEFECTIVE PINNING

Consists in boring holes in pin block in wrong position, causing string of one pin to pull against another pin, *lap over* or *rattle* against other strings, and crowd over on bridge, as already noticed. See "Defective Wrest Pins in Square Piano."

If hole is too large, pin will be driven so low as to necessitate the removal of lower coil of wire, or the filling in of hole, as directed, with veneer, or introduction of larger pin.

When pin drives too tight in block, Stringer sometimes crushes pin at string hole, by heavy driving, and this will result, sooner or later, in pin twisting off at pin hole. To remove see page 31.

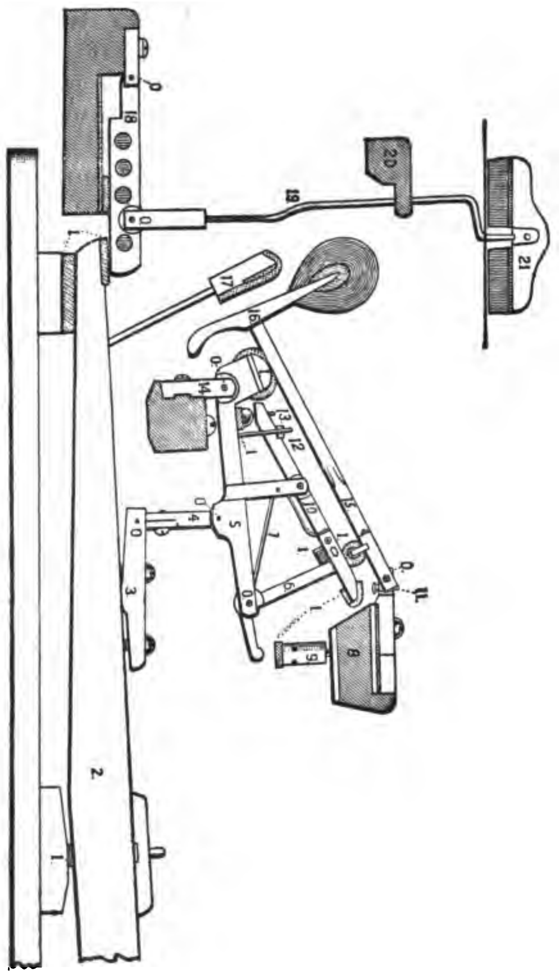
DEFECTS OF WREST PIN BLOCK

Are very few in the Upright Piano.

In rare cases block may tip, from pull of strings, and lack of sufficient bolting and bracing; or outer veneer may check and split; but as the wrest pin blocks of uprights are now made up of veneers with grain running in all directions, no split can extend beyond the thickness of any one veneer. See "Defective Pinning."

DEFECTS of BRIDGES and AGRAFFS are similar to those in squares, and the same may be said with reference to sound-board bridges. Iron Plates have few defects. There is less wind, or twist, in the upright piano than in the square, and a broken iron plate is rarely found.

In some makes, the Hammer Flange is made of brass in one continuous piece, or in sections; with regulating screw to close the metal clip, which should always be tight on centre pin of Hammer.



Grand Piano Action.

GRAND PIANO ACTION.

1. Indicates the cloth, leather, or felt, upon which the various parts of the action rest, or fall noiselessly.
2. Key.
3. Rocker.
4. Sticker, or Lifter. Adjustable with screw.
5. Lever.
6. Jack.
7. Jack Spring.
8. Flange and Regulating Rail.
9. Regulating Screw, Button, and Cushion.
10. Escapement Lever.
11. Regulating Screw in Hammer Flange, for Escapement Lever.
12. Check Wire, for Escapement Lever.
13. Screw to regulate fall of Escapement Lever.
14. Lever Flange, screwed to Flange Rail.
15. Hammer Stem.
16. Hammer.
17. Back Catch.
18. Damper Lever, leaded.
19. Damper Wire, screwed into wood upright.
20. Damper Wire Guide, fastened to Sound-Board.
21. Damper Head and Felt.

o. Centre Pins. Holes bushed with cloth.

CHAPTER X.

GRAND PIANOS.

ACTION.

THIS form of construction, known as "Swiss Action," has fewest defects and most advantages, and is the one almost exclusively used in grands by manufacturers.

Keys are subject to a few of the same defects as keys in uprights: remedies same.

Action has even less to contend with than has upright action, and any defects are as easily remedied.

To obtain less tone, the whole key-board and action is moved to the right by soft pedal, that hammers may strike two, instead of three strings.

If soft pedal is much used, this will cause more rapid and uneven wearing of felt on hammer. For a piano supposed to be used mainly by advanced musicians, or artists, this method of obtaining diminished tone is not the most artistic.

If one wishes for light tone, the requisite practice will enable them to command any shade, with hammers still striking three strings.

It is the opinion of writer that artists rarely call the soft pedal into use.

Frequently the key-board and action works forward, and hammers of extreme treble strike pin block, and stick, or fail to give string full blow. For loss of tone in treble look first for this, as hammers pound down on top and spread out on the sides, thus striking pin block, or plate; and frequently strings cut so deep into hammer felt as to allow side of hammer to strike block.

Hard use will flatten hammer heads and result in poor tone. Point hammers as already directed.

There is seldom any alteration required in action of grand piano, and tuners will find little occasion to change same.

If damper levers, or damper wires stick, or work sluggishly, use oil, or alcohol, as directed; and same for all sticking, solid joints in action. Regulating screws once adjusted, they require turning only at long intervals when actual use has pounded down, or worn out, leather, cloth, and felts.

The few defects of grand pianos have their counterpart in the other styles, and can be remedied same as there directed.

CHAPTER XI.

TUNING.

ASIDE from the length and size of wire, the pitch of a string is determined by the tension, and this tension is obtained by the winding up of one end of string on wrest pin, which pin is driven tightly into wrest block, the friction of pin in block retaining the tension thus obtained.

Strings of equal size and length are in unison when tension is the same, and to adjust this tension a tuning-hammer (wrench) is used, and the ear determines when the unison is obtained.

One string of a note, usually the left hand, is first drawn up to desired pitch, (the others having been "damped" by wedge) then raise the pitch of second string (damping third if there are three strings to each note) until, from the confused noise of the two strings, there issue well defined beats, or pulsations, which in turn are superseded by gentle waves, followed by the disappearance of all waves, and resulting in one smooth, continuous tone.

The pulsations, or waves, are produced by the recurring periods when the vibrations of the strings coincide and again interfere, and it is very important to familiarize the ear with these waves, for by them one is enabled to assign to each note its relative rate of vibration, in order that each note within the octave can be taken as the root of its own key, major or minor; and all intervals employed in harmony, be made to satisfy the demands of the ear.

In the process of tuning, the unison comes first under notice, and will afford practice for the ear to become familiar with the appearance and disappearance of the beats and waves; also enable the hand and wrist to acquire some of that control of the hammer, necessary to turn the tuning pin as desired.

Unison will be perfect when tension of strings is alike, and then all beats and waves will have given place to one continuous tone.

Having tuned the unison, proceed to the octave, in which the rate of vibration of string in upper note is as two to one of the lower, yet, when in tune, the ear will receive them as one tone. Next, tune fourth and fifth perfect, in order to become familiar with them, and to learn later how much to vary them in laying the temperament.

All of above, when tuned, should be free of waves, or pulsations, only excepting when there may be a false string. See "Defective Strings."

To insure piano standing in tune, strike the key repeatedly with a firm blow, and move the pin in block either way desired, but never spring, or bend pin by bearing on hammer.

The more evenly the tension of the string is distributed over its entire length, the better will the piano stand in tune, every thing else being equal. See "Why Pianos get out of Tune."

PITCH.

To tuners more than to any others, will musicians have to look for a standard pitch. There is to-day no agreement between piano manufacturers, or any number of musical societies, regarding a standard; and at whatever pitch manufacturers may turn out their instruments, the tuner, in most cases, determines the pitch at which piano is kept.

If tuners wish to send their forks, with fifty cents, by mail or express, prepaid to the Author, care of Publishers of this book, they can have them tuned to French Pitch. $A_3 = 435$, or $C_3 = 258.6$ an equally tempered major sixth below, the only standard having any acknowledged authority, and the one nearest approaching that point upon which all parties interested will ultimately agree.

For old pianos, or those showing weakness either in case, plate, bracing, or bridges; or already having broken strings, or strings from which all elasticity is gone, and liable to break in tuning, it will be best to raise the centre notes but little, if any, above the pitch of extreme notes in treble and bass; and, where any considerable elevation is desired, it will be best to go over the piano repeatedly.

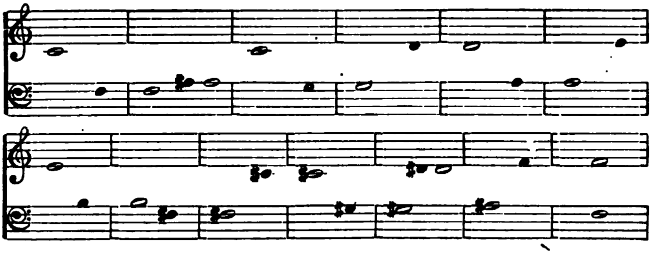
Sometimes a piano can be coaxed, in this manner, up to a pitch it would not otherwise stand.

If piano is again looked over in about ten days after having pitch raised, it will benefit piano, and give greater satisfaction all around.

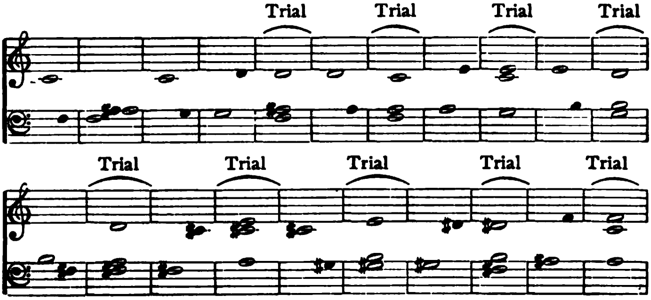
Where piano requires such treatment, an additional charge should be made, and time taken to do work thoroughly.

A chalk mark on the top of wrest pins to strings F. A. C. F. will facilitate the setting of temperament by aiding the tuner to find more readily, and with greater certainty, the right pins for each note. The damper shade buttons placed beside the wrest pins will answer the same purpose. Blind men who tune, place paper washers over the pins.

TEMPERAMENT.



THE ABOVE TEMPERAMENT, WITH TRIALS.



TEMPERED INTONATION.

The knowledge of how to set an even temperament can no more be imparted by written rules, than one can learn to paint a perfect portrait by being given the angles and measurements.

However, the writer, after more than twenty years' experience in tuning, and teaching others to tune, believes the following method to be the best employed, and the rule as near perfect as the art will admit.

RULE.

Tune middle C to desired pitch, then tune F — fifth below — sharp of C, until between C and F, there result three beats in five seconds. Next tune A sharp — fourth above F — sharp of the latter, until there results one beat each second.

Next tune G — fourth below middle C — flat of C, by one beat a second; then tune D — fifth above — flat to G, by three beats in five seconds; A — fourth below — flat to D; E — fifth above — flat to A; B — fourth below — flat to E; F-sharp — fourth below — flat to B; C-sharp — fifth above — flat to F-sharp; G-sharp — fourth below — flat to C-sharp; D-sharp — fifth above — flat to G-sharp, which will make D-sharp, as sharp of A-sharp, as the latter is sharp of the first F tuned.

In all the above intervals, the fifths beat three times in five seconds; the fourths beat once a second, or five times in five seconds. All the twelve notes, from F below middle C to first E above, have now been tuned; the temperament has been confined to the smallest possible compass to lessen the liability of errors, and if the first F above middle C is now tuned three beats in five seconds, flat of A-sharp below, it will be a perfect octave to the first F tuned.

Frequently the tuner may "come out right" — the last F tuned being a perfect octave to the first F — and yet the temperament not be even.

Trials alone, by thirds or chords, must *not* be relied upon, if one wishes to set a perfectly even temperament.

Beginners should always tune the intervals, first absolutely perfect, then sharp or flat them as required. While tuners of more experience, can determine the relative position of the two notes, and are less liable to be deceived by getting onto the wrong side of the interval, yet all would do uniformly better work if each note were perfectly adjusted, as per above rule, before proceeding to tune the next note.

The fact that in tuning any note a tempered fourth or fifth, it will beat the same when either sharp or flat, should cause tuners to observe the rule given, and not trust to trial by chords, for if the rule is followed, there will be no "proof" required.

Some pianos, will not admit, apparently, of as close tempering as others; this is due however to the presence of harmonics in the separate strings, which mislead, or confuse the tuner, and are caused by kinks, flaws, or other inequalities of the string; by imperfect bearing of the string at either end, or disproportionate length; and often all the strings of the piano may be more or less false through incorrect drawing of the scale, by which some of the upper partials, or harmonics, become more prominent than the fundamental tone, making it difficult, if not impossible, to tune unisons perfect.

In this case tune first the least faulty string, then the others of same note can be adjusted to it by tuning them sharp or flat as required; as vibrations of the harmonics can often be dissipated, or neutralized, by interfering waves of unison strings when very slightly sharp or flat.

If distribution has been evenly made, as per above temperament, all trials will be even, all chords so shaded as to be most agreeable to the practised ear.

From the great prominence of the second partial tones of the strings in this part of the piano, is due the slow beats of the tempered fourths and fifths, making the notes from F below middle C to F above inclusive, the most desirable for tempering purposes.

Sometimes a string (more often a bass string) gets so much out of tune that the unpractised ear fails to determine whether it is sharp or flat.

In this case, press the finger on string midway between the back and sound-board bridges, strike the key, and the octave harmonic will be heard, when by striking the adjoining keys in succession, the pitch of string can be determined by its nearest approach to some one of the keys struck.

After temperament has been set, tune, by octaves, the lower half of piano, testing all octaves by fourth and fifth.

In tuning up the scale by octaves, remember that the lower tone seems to overshadow the upper, and the ear will often be satisfied with a flat octave, and this repeated in each successive note, will give a very unsatisfactory treble, while no one note seems to be at fault.

To avoid this error (caused by the arbitrary estimation of the ear) make each note beat the same number of times a second with the tempered fourth below, and its octave (fifth above); also use trials of successive tenths, which should beat faster going up the scale. A very slight sharping of the octaves, increasing as the extreme notes are approached, will insure the most satisfactory results. See "Why Pianos get out of Tune."

TO OBTAIN THE BEST RESULTS IN TUNING

The temperament should be first gone over, putting the strings slightly above the pitch at which it is desired piano should be left.

Then tune down to overstrung bass and up to treble brace, if a square piano; or to second brace in treble if a grand or upright.

Then go over temperament again, after which tune first down, then up the entire scale of the piano.

The instrument should now be played upon, sufficient to beat out any strings liable to either flat or sharp (and strings, when played upon, often sharp as well as flat, especially where agraffes are used), and to give all the strings time to adjust themselvs to any pulling, or giving, of the frame, case, blocking, and bridges of the piano.

Should there be any adjusting of action, or other slight work necessary to be done on piano, now would be the the best time in which to do it, after which go carefully over the temperament again, and finish by tuning through first the bass, then upper half of the piano.

Other things being equal, that piano will remain longest in tune, which has been given by the tuner the longest time to adjust itself to the variation of strain, caused by the tuning.

Where two pianos are to be tuned to the same pitch, the second one must be drawn a shade sharp, to provide for any falling in pitch; and where a piano is to be tuned to any wind instrument, piano should be left a trifle sharper, to provide not only for the natural falling of the piano, but for the raise of pitch of the wind instrument, through its becoming heated in use.

Concert Tuning consists in tuning well any piano, generally a grand, for use in concerts.

CHAPTER XII.

HOME CARE OF THE PIANO.

THE question is often asked, "would it be best for the piano if it were closed at night?" Any care or precaution that will aid in keeping the instrument from dust, and sudden or extreme atmospheric changes will be best for the piano. To unnecessarily expose an instrument by leaving the lid or cover open at any time, day or night, is, however, no more ruinous than to keep it closed too long from the sun and air.

In the latter case, piano sweats, strings and other metal parts rust, action sticks, ivory keys turn yellow, and moths are left undisturbed to destroy the cloths and felts. Gum camphor wrapped in paper and laid inside, is thought by many to protect the piano from moths; or place one or more stems of hemp, leaves and blossom, inside where they will not interfere with the action. This is used in railroad car seats, and said to be effective; but the writer's experience is that nothing but a thorough brushing, at least once a year, of all cloths and felts throughout the piano, can be safely depended upon.

If the strings are rusting it is a sure indication of dampness.

In dusting, brush lightly over the case with dry cheese cloth, which will be found superior to chamois skin, or silk.

Never rub varnished surfaces with anything dry.

If varnish looks cloudy, or streaked, wipe with cheese cloth dipped in tepid water and wrung dry.

Seldom use any polish, and then sparingly, being careful to remove surplus oil.

A piano, or organ, should not be placed near an outside wall, and should be removed, so far as possible, from draught of doors or windows, and the hot air from furnaces.

To aid in preserving the whiteness of ivory keys, wipe them after playing, more especially in warm weather, and should they show indications of turning yellow, clean them with alcohol and water, equal parts, using care not to touch any varnished surface. Exposing them to sunshine will aid in retaining, or restoring whiteness. (For piano polish see page 97.)

WHY PIANOS GET OUT OF TUNE.

One great cause of pianos getting out of tune, is that, while the strings may be left by tuner all in accord, and the piano sound well at first, the pins have been bent, twisted, or sprung, and the strings not properly rendered over the bridges, or through the agraffes, so that with a little use, the strings either fall away or sharp, and piano is more out of tune than ever.

There is an art, which comes only after long practice, by which the tuner can feel, through his hammer, when the pin moves in the block, and when the string renders over the bridge, or through the agraffes. Frequently the pin springs, or winds, without turning in the block; frequently it twists at string hole; and often turns in block, tightening string from pin to back bridge or agraffe but string not rendering freely over, there is a much greater tension from pin to back bridge, than from back bridge to sound-board bridge: and when piano is used, the tension will equalize itself, thus sharping that note in proportion as the string renders over bridge, or through agraffe.

The ill effects of bad tuning should not be chargeable to the piano, but unfortunately the piano has to stand all the blame, as it cannot speak for itself, and few owners of instruments, even professional musicians, or dealers, understand just where the fault lies.

The upright piano of to-day is so well constructed that even one of the cheapest makes will stand well, if tuned by a good tuner, whereas the best makes fail often to give satisfaction because of poor tuning.

Pianos get out of tune because the blocking gives, compresses, or shrinks, letting the pin block down; or the pin block itself shrinks, or tips forward (the latter defect more especially in upright pianos), because of the pull of strings, and lack of sufficient bolting; or because of defects in wrest pins, as in square pianos; or because strings may lap one another back of bridges, or pull against another tuning pin, and when this pin is moved, the string already tuned, is moved, and thrown out of tune; or because strings slip sidewise under bearing bar, and on bridge.

The gradual stretching of strings (until in a few years all elasticity is gone), and the contraction and expansion of the string, due to atmospheric changes, affect the standing in tune. These atmospheric changes affect the iron plate and case, the latter often in a manner the reverse from the strings and plate, for when the iron contracts, the wood may expand, and *vice versa*.

All pins in sound-board bridge give more or less, also string cuts into bridge, and until the string has become thoroughly settled here, and at hitch or plate pin, and in fact all bearing points, the piano will not remain well in tune.

If sound-board sinks under strings, this will affect the tone, as well as throw piano out of tune.

The upright piano has not, either in case, frame, or iron plate, the weak places common to all squares, and outside of those already noted, there are few, if any, faults in case or plate that affect the standing in tune. If tuning pin is properly set in block, any getting out of tune will be due to string and bearings.

Pianos stand best if tuned after, rather than before storms, or other marked atmospheric changes: and these same changes often affect the action, causing a sticking of joints, more especially in pianos of the better grade. Pianos may be knocked out of tune by too heavy playing, or by blocking hammer, or when hammer is regulated too close to string. See defects of strings and wrest pins, as noted in square pianos.

Pianos when new do not stand in tune as well as after having been used a year or more.

The first year requires, and should receive, frequent attention of tuner until strings have stretched, action become well adjusted, and the whole piano thoroughly settled.

After this, piano should be tuned at least twice each year, and it would be better if tuner could have care of it by the year, and keep it always in order.

CHAPTER XIII.

Repair Department.

TOOLS.

Every tuner's kit should have a *felt picker*. Good ones can be made by gluing together two pieces of wood (rosewood is best), between which place three No. 5 (between) needles, evenly spaced, and fix in vice until glue has set; then finish off wood into handle of desired shape, and wind needle end tightly with thread.

Felt Pickers, with adjustable jaws, to hold needles, can be had of any dealer in piano tools. *Wrest Pin Extractor*. See page 31. *Key Punch*. See page 18.

A SAND FILE

can be made by gluing sand-paper on a thin strip of wood (cigar box cedar) six inches long, three fourths of an inch wide, and thickness of cigar box stuff.

EMERY HONE

can be made by gluing emery cloth to wood of desired dimensions. If spruce is used, leave one side bare on which to finish edge of knife.

DRILL FOR WOOD.

The best drill for bridge pins is made from one of the pins to be used. File one end flat on two sides, evenly, then point by filing across the end at an angle of about twenty-five degrees, beveling each side to make a cutting edge.

Using a drill made of the pins to be driven will make the hole of exact size desired, and if drill is thrust into a piece of soap each time a hole is bored, the drill can be used a long time.

PIANO WIRE

also makes fine drills, especially for boring in metals; and if all drills are kept wet in camphor and alcohol, they will bite faster, and even bore through glass.

RUBBER WEDGES

can be made more evenly if cut in water, and if thin end of wedge is cut at a slight angle, it will hold better between the strings.

Any roughness of surface of wedge can be better removed by rubbing it against any flat surface than by trimming with knife. Long felt wedges are also good.

TO TEMPER SCREW-DRIVERS,

Heat to cherry red, and drive into a bar of lead.

TO TEMPER DRILLS,

Heat points to a grayish blue, verging on black, and plunge into a tallow candle.

TO TEMPER ALL WOOD CUTTING TOOLS,

Heat to a brown, with purple spots, and cool with candle, or in oil.

TO TEMPER COLD CHISELS,

Heat to a dark blue, and cool in oil, or water; oil preferred.

TO CLEAN FELT HAMMERS.

Use fuller's-earth, or tailor's chalk.

TO WHITEN IVORY KEYS.

Use sapolio and water, finish with alcohol and whiting; or use soap and alcohol.

IVORIES

Which are very yellow, or have become worn in the centre, require to be worked down, and re-polished.

There are scraping irons and planes for this purpose, but the following method will be found superior to any other:

Remove black keys from key frame, press white keys down in front and fasten by suitable strip of wood running over all the ivory keys just in front of centre pins.

Next, tack No. 1½ or No. 2 sand-paper smoothly over a rubber, made of wood, six or eight inches long, four inches wide, one inch thick.

With this rub the keys until yellow is removed, and ivories are again even. Rub back and forth, never across the keys, working up and down the key-board.

TO POLISH.

Use a rubber made same as above, covered with rubbing felt in place of sand-paper.

Wet the felt through first with water, then apply a paste made of French whiting and alcohol, and rub until polished. Clean off ivory with cloth and alcohol, and clean sides and top of key with knife blade, or sand-paper.

By securing firmly all the ivory keys on the key frame, they are held true by the pins, and using the rubber as directed, several keys are whitened at the same time, and all worked down evenly, whereas, if keys are worked over separately, either with plane, scraper, or by sand-paper rubber, no one but an experienced hand could make an even job.

If any ivory dust lodges in sand-paper, remove it, or it will cut a deep scratch in the ivory; and in finishing, be sure to remove all fine scratches, as they will show when key is polished.

If black keys were polished, and polish has worn off at ends and looks dull, use French polish.

TO LAY CELLULOID.

Coat it with celluloid cement, lay quick and press tight between cold cauls.

When taken out of the press, let it stand for ten or more days, to thoroughly dry, then scrape it same as ivory; rub it down with fine pumice stone slightly moistened with alcohol.

FOR POLISHING,

Use alcohol with coal oil, or crude oil, and felt, or cloth, rubbing with force; alcohol and water, equal parts, will also give a fine finish. Celluloid can be bought in single octaves, or sets of five, or seven and one-third octaves, either for tops (bevel sheet), or fronts.

Scroll — A foot of fronts is one inch wide and twelve inches long. In laying celluloid, use only the cement prepared for this purpose, which can be obtained in any quantity desired.

To clean silver or nickle plate, use a polish made of alcohol, one half pint; French whiting, one ounce; spirits of ammonia, one drachm.

To remove ink stains out of mahogany, rosewood, or cherry. Put a few drops of spirits of nitre in a teaspoon of water, touch the spot with a feather dipped in above, and on ink disappearing, rub it over immediately with cloth, or sponge, wet in clear cold water, or it will leave a white mark.

Stains from *mahogany* can be removed with *aqua-fortis*, or oxalic acid and water, rubbing the stained spot with the liquid, by means of chamois skin rolled into a point, until color is restored, then wash off in clean water and polish.

IRON AND STEEL RUST PREVENTIVE.

One ounce camphor, dissolved in two pounds of lard; skim, and mix in black lead to give an iron color. Apply and let remain twenty-four hours, then dry off with clean cloth.

CEMENT FOR CLOTH AND LEATHER.

Gutta-percha, one fourth pound; India rubber, one ounce; pitch, one half ounce; shellac, one fourth ounce; oil, one half ounce.

Melt together, and use hot. This is excellent for mending leaks in cloth, or leather, of bellows and exhausters in organs, as it is pliable as well as strong. A solution of gutta-percha in bisulphide of carbon is better.

WOOD STAINS.

BLACK.

Boil one half pound of logwood chips in two quarts of water and one ounce of pearlash, and apply hot with a brush. Then take two quarts of logwood decoction, and one half ounce of verdigris, and the same of copperas strain, and throw in one half pound of iron rust. Brush the work well with this and oil.

BLUE.

Dissolve copper filings in *aqua-fortis*, brush the wood with it, and then go over the work with a hot solution of pearlash, two ounces to a pint of water, till it assumes a perfectly blue color.

GREEN.

Dissolve verdigris in vinegar, and brush over with the hot solution until a of proper color.

CHERRY COLOR.

Red sanders and alcohol. Proportion according to depth of color desired; or apply stain, until desired shade is obtained. If surface is first wiped over with oil, color will take better. The longer stain stands before using, the darker it becomes.

MAHOGANY COLOR.

Boil one half pound of madder and two ounces of logwood chips in a gallon of water, and brush well over while hot; when dry, go over the whole with pearlash solution, two drams to the quart.

LIGHT RED-BROWN.

Boil one half pound of madder and one fourth pound of fustic in a gallon of water; brush over the work when boiling hot, until properly stained.

RED.

Boil one pound of Brazil wood and one ounce of pearlash in a gallon of water, and while hot brush over the work until of a proper color. Dissolve two ounces of alum in a quart of water, and brush the solution over the work before it dries.

IN IMITATION OF ROSEWOOD.

Boil one half pound of logwood in three pints of water till it is of a very dark red, add one half ounce of salt of tarter; stain the work with the liquor while boiling hot, giving three coats; then, with a painter's graining brush, form streaks with black stain; let dry and varnish.

WOOD STAINS

Ready made, can be had of all dealers in piano materials; and *Le Page's* glue, ready for use of same, or at most hardware dealers, or druggists.

TO MATCH KEYS.

Where ivory has turned yellow, and no old ivory can be had to replace one broken, or lost, smear new piece with lemon juice, acetic acid, or with sweet oil, until required shade is obtained. If oil is used, let it remain on over night, but do not allow it to get on under side or glue will not hold ivory to key so strong. *In gluing ivory* to keys, if top of ivory is dampened it will be less liable to warp, and pull from key.

TO TAKE BRUISES OUT OF PIANO OR ORGAN CASES.

Wet the part with warm water: double a piece of brown paper into several thicknesses, soak in warm water and lay over bruise. Then hold a warm flat iron over, not on it, until moisture of paper is gone.

If bruise be not raised even with surface, repeat, but be very careful to use iron only warm, or varnish will be scorched. When perfectly dry, touch up with black varnish.

Above is easier than to "burn in" shellac, and quicker than to fill in with varnish.

TO MAKE STICK SHELLAC

For burning, heat shellac in hot water, and form into stick while plastic.

To patch case, use a strip of veneer, and burn end of shellac, dropping hot shellac into hole to be filled, pressing it, as it cools, with thumb or fingers, well into place.

When hole is filled, even off with some thin flexible tool (an old table knife is good), heated with the burning veneer. Finish with fine, flat file, pumice-stone, quick drying black varnish, if required, and French polish to finish.

A RUBBER FOR POLISHING

With pumice, or rotten stone, can be made same as that for polishing ivory keys. Rubbing felts can be had of felt makers, or dealers in piano materials.

TO CUT VARNISHED VENEER

Without flaking the varnish, keep the knife blade, or other cutting tool, wet with turpentine.

EMERY POLISH.

Emery powder, lard, and gum camphor mixed to a paste and applied with a cloth to plain strings, or other bright metal surfaces (not plated), will be found superior to fine sand-paper, or emery cloth, for removing rust or other discoloration, doing the work better, and in one quarter of the time.

TO CLEAN POLISHED STEEL.

Ten parts tin putty.
Eight parts prepared bucks-horn.
Twenty-five parts spirits of wine.

Rub with this, and clean off with blotting paper.

CELLULOID CEMENT.

One part shellac, disolved in one part spirits of camphor.
Three to four parts of 90 per cent alcohol.
Keep in closed bottle.

DEFECTS OF VARNISHED SURFACES AND HOW TO REMEDY.

The most common defect of varnished cases is that of checking, due to piano being exposed to excessive dampness, causing glue in veneer to swell, and grain in veneer to rise and check varnish.

If case is badly checked, it will be best to scrape off all varnish to veneer, and re-varnish. If only slightly checked, it may be rubbed down with powdered pumice-stone and water; finish with rotten-stone and water and then polish.

If case is scraped to veneer, it may be best to use a filler first. Fillers, ready made, can be had of dealers in piano materials; also materials for ebonizing, and varnishes, in any quantity desired, ready for use.

In flowing varnish, be sure surfaces are clean and dry. Flow in a warm room, free from dust, and where piano can be left undisturbed until hard.

The kind of varnish used, how thick, or thin it is put on, and the weather, all help determine how long it must dry before rubbing, or before another coat can be added. Be sure coat is not only dry but hard, before rubbing; also before adding another coat, for if one coat is added before the other is dry, it will prevent first coat hardening. If desired, directions will be sent with varnish, by dealers.

In rubbing varnish, finish off rotten-stone with bare hand, rubbing hand over piano, then over a wet chamois skin, held in the other hand.

Remove all rotten-stone before putting on polish, or it will look clouded. Apply polish with a wad of cheese cloth, wipe off with a clean piece of same; dust wheat flour over piano case, and finish off with cloth in a wad, VERY SLIGHTLY dampened with alcohol. Use but little alcohol, or varnish will be burned, and turn white. Varnish cannot be hurried.

Never use a cheap brush, for hair will shed and spoil the job.

Dryers can be added to hasten the work, but varnish once applied, must be given necessary time to dry.

In mixing polishes for cases of old pianos, use a greater proportion of oil than for new work.

In ordinary wareroom cleaning of new work, use no polish. Wash off with cheese cloth, and dry with same wrung out dry.

FRENCH POLISH.

Spirits of wine, one half gallon.
Sandarach, one ounce.
Shellac, six ounces.
Mastic, one half ounce.

PIANO POLISH FOR OLD CASES.

Alcohol and butter of antimony, each, one and one-half ounce.
Acid muriatic, one eighth of an ounce.
Linseed or sweet oil, sixteen ounces.
Acetic acid, one ounce.
Ammonia, two drachms.

PIANO POLISH FOR NEW CASES.

Raw Linseed Oil, one pint.
Common muriatic acid, one ounce.
Turpentine, one ounce.
Benzine, or Gasoline, three pints.

Apply with wad of cheese-cloth, slightly dampened with water.

LEATHER AND FELTS.
HOW TO SELECT, PREPARE AND USE.
HOW TO TONE.

In selecting leather for covering hammer heels, get action skins of a firm, even grain and quality, that will not pull or stretch. For covering old leather hammers, use the thick, softer red, or heavy brown shade of capping buckskin, either with or without grain. Do not use the skins which one way seem firm, but if pulled the other way draw out into a string.

In ordering skins, state for what purpose you want them, and dealer will send the kind required. In cutting skins for capping, run grain the way of least pull, to insure best tone.

In capping old hammers, prepare them by shaping with pliers, as directed, on page 18, for interfering hammers; then shave if required, from either side of hammer, enough to admit the leather capping and hammers still not interfere.

Cut capping leather wide enough to allow for shrinkage in pulling. Cut caps long enough to come well down the sides of hammer, and pare off either end of leather, on under side, to a feather edge. To do this well requires a sharp felt knife.

Use hot glue of thicker consistency than for wood work, smear sides of hammer, lay centre of cap over top of hammer, and draw tight by pressing between the palms, and ball of the thumbs; hammer being held up by a block of wood, beveled to lay on stems against hammers, and over which rests the stem of hammer to be covered. When glue is hard, trim edges of leather even with hammer, and finish with sand file and felt scissors.

IN TONING FELT HAMMERS.

Stab them with felt picker, but do not raise the wool to make hammer soft on top. If hammer is too soft, shrink wool with damp cloth as directed on page 18.

In covering hammers, be sure no glue gets on top, or so far up the sides of hammer as to come in contact with the string.

CHAPTER XIV.

CABINET ORGAN.

CONSTRUCTION, DEFECTS AND REMEDIES.

THE interior consists of pedals, which work the exhausters, that exhaust the air from the bellows, leaving a vacuum into which the outside air passes through the reeds when valves are opened by pressure of keys. Tone is thus made by drawing the air through the reeds, and not forcing it as formerly done in harmoniums.

This, together with the voicing of reeds, by bending, or curving the points of tongue, to qualify and modify the tone, constitute the radical improvements that have made the organ so popular.

The defects liable to keys of organ, are sticking on pins, remedy same as piano keys; depression of front end of key, and consequent opening of valve, by key strip being screwed too tight on back end of key.

Defects of organs are liable in *stop action*, *reeds*, *valves*, *exhausters*, *bellows*, *pedals* and *case* in the order named. No special directions are needed as to repairs of case.

PEDAL DEFECTS

Are usually confined to a worn or broken pedal strap easily repaired, or replaced with new webbing; squeaking of hinges, working out of hinge pins, and screws; and wearing out of pedal carpets.

DEFECTS OF EXHAUSTERS,

Are, 1st, looseness of valves (long strip of sheep skin tacked on outside of exhauster); to remedy which remove tacks at one end, draw smooth, and re-tack; and, 2nd, any injury to folds of cloth, same as in bellows.

THE SAFETY VALVE

Is fastened to exhauster, and the only defects it is liable to, are dirt lodging on valve seat preventing its closing tight; displacing of valve; or breaking of hinge; displacing or breaking of valve spring; or displacing of screw which, from the inside, opens valve; valve should open about one fourth inch, when bellows are fully contracted.

Valve can be regulated by screw beneath it.

TO GET AT THE BELLOWS AND EXHAUSTERS.

In nearly all makes of organs the backs are made paneled, and some makes have panels in front; which remove to get at bellows and exhausters.

A leak in the bellows can be detected by the pedals being drawn forcibly up, after having been pressed down. If the bellows springs squeak, oil them, or rub on yellow soap.

TO GET AT THE REEDS.

Remove key strip, held in place by screws at ends, also swell strip, which runs front of the reeds under the swell, in some makes; draw the stops, and the reeds can be seen. The back set of reeds are reached the same as those in front, after removing panel, or back of case. To take out a reed use the reed hook, sent with each instrument.

Carefully place the hook on the rivet end of the reeds at opening of reed cells (some reeds have shoulders, or depressions, by which to withdraw them.)

If the note fails to answer when the key is pressed down, take it out, and if there is dirt in it, which can be seen by holding it up to the light, remove it by striking the end of the reed block with the hook.

If the tongue is pressed out of place, this will prevent its speaking. The best way to tell when a tongue is out of place, is to compare it with the next reed which is in perfect order.

When the notes rattle, which the lower ones often do, on account of the side of the reed block being pressed against the tongue, press the reed on either front corner to be sure that it is in its place firmly. If it still rattles, the sides of reed block are cramped by reed cells, and reed block should be filed slightly to free it.

The greatest care must be used in touching reeds, more especially the upper ones.

TO REMEDY FAULTS IN THE ACTION OF ORGAN.

If a key sticks find the cause, and remedy the same as in piano.

If the *push down pin* sticks, black lead it, after having sand-papered it.

If a *note continues* to sound, there is dirt under the valve; or the valve has been pressed down beyond the guide pins. The dirt can be removed, and sometimes the valve replaced, by inserting a wire in the push down pin, or sticker hole, and carefully pressing down the valve, at the same time working it to either side, when it will spring back in its place; excepting when the spring is weak, broken, or has slipped off from the valves.

In this case, the action will have to be removed to get at the valves. Proceed as follows: —

Open the swell, draw out the swell strip, and the screws can be seen in front which hold the action down.

It will be necessary to remove key cheeks, stop action, and perhaps the box containing sub bass set of reeds, if placed separate, as they often are, on top of reed boards, to get to all the screws which confine the reed board to bellows, on all sides.

IF VALVE-SPRING IS WEAK.

Curve it by drawing it over the ball of the thumb; do not make a sharp turn or it will be still weaker. Old instruments, the valves of which were covered with rubber cloth, often give annoyance by the valves sticking to the valve seat; this can be remedied by replacing the rubber with leather, or sheep skin. In renewing valve leather, use quite thick glue, hot, and put glue through centre of valve cloth so as to leave edges of leather soft and free all around, or valve will click on valve seat when glue gets hard and will be likely to leak air.

Great care must be used that the valves do not conflict; also that the valve springs are not weakened when taken out. It is often necessary to replace the old springs with new and stronger ones.

IF THE BELLOWS BOARDS LEAK.

Make them tight by gluing leather over the leaks, or running a saw through split, and glue in a strip of wood to fill.

IF BELLOWS CLOTH LEAKS.

It can sometimes be remedied by sizing with cement (see page 92), or by soft leather glued, or cemented, on the inner side, but it oftener happens that it is necessary to re-cover the bellows. This is not an easy job to do nicely, and requires care and judgment.

Remove the old cloth whole and cut out the new one by it.

This cloth can be obtained at any organ factory, or dealer in piano and organ materials, and often at hardware stores. To remove the cloth begin at one corner, and as soon as it is removed sufficient to admit the hand, secure the spring to prevent the spreading of the bellows and consequent tearing of the cloth.

When the new cloth is put on, to counteract the force of the springs, use set screws, or any other available means at hand, to hold the bellows in place, until the glue is hard.

In replacing the key-board and action upon the bellows, see that there is nothing on the leather packing to prevent its screwing down close. Also see that no screws are omitted, for if so the wind will escape.

When taking any organ or piano to pieces, lay each screw, and different sized screw, piece, block, pin, or whatever is removed, by itself, so that there will be no difficulty in returning them to their proper places. It would also be well to take a general observation of the work before removing any part, and to mark, or number, each piece as removed.

When a reed is broken, draw it out and send by mail to the manufacturer with the next note an octave nearer the middle of the instrument as a guide to tune by; always enclose with the reeds, or write on the tag outside, full address, so factory shall know to whom reeds are to be returned.

The back catch holds the back end of the keys in place; this must be removed in order to take up a key, and when put back in place, see that it is *not so tight* as to depress front end of key, yet tight enough to hold back end firmly in place.

When the keys are removed from the action, or when the valves are removed, be sure that the action is not turned over in either case, as this will displace the push down pins: and when it is necessary to remove any number of pins, be sure they are returned to the same holes they were taken from, or the key-board will be uneven.

There is seldom need of scraping, or filing reeds. If a reed is out of tune, take it out, and with a small stiff brush remove the dirt from the tongues, brushing from the rivet end to point of tongue to prevent breaking tongue. Should reed be much rusted, or corroded, it may require scraping, or filing.

If reed is so much out of tune, as to make it difficult for one not experienced to decide whether it is flat or sharp, press down the key, with the one an octave nearer the centre of organ, and gradually let the key of the one to be tuned come up, when the vibrations will grow slower or faster; faster if the note is flat, and slower if too sharp. To flat or lower the pitch of a reed, file or scrape at the heel; and at the point, to sharpen or raise its pitch.

If reed is too flat, and tongue will not stand any more filing because of its thinness, bending it slightly back and forth may sharpen it enough. If a bass note has suddenly sharped it is quite sure the tongue is cracked. This is a common fault in the largest reeds.

A slip of writing paper passed under tongue, and over reed block will hold tongue up, while being worked upon.

Little filing or scraping is required to effect reed materially, and for upper notes, a slight scratch of knife point is often sufficient to alter tone all that may be needed.

APPENDIX.

MATERIALS USED IN THE CONSTRUCTION OF PIANOS.

WOODS.	WHERE OBTAINED.	WHERE USED.
White Pine.	Native.	Bottom and bracing of Case in Square Piano; Blocking in Uprights and Grands; Key-boards, Frames, Beds, etc., in Grands, Uprights and Squares.
Chestnut.	Native.	Cases.
Oak.	"	"
Chinaberry.	"	"
Cherry.	"	"
Ash.	"	"
Lime Tree.	England. (Seldom used now.)	Key-board.
Deal.	Norway.	Bracing.
Spruce.	Principally Northern N. Y. and N. H.	Sound-board.
Mahogany.	South and Central America.	Veneers, various parts of Action, Buttons, Mouldings, etc.
Maple.	Native.	Wrest-plank or Pin-block, Sound-board bridges, Leg-pins, etc.
Beech.	Native and England.	

WOODS.	WHERE OBTAINED.	WHERE USED.
Birch.	Northern N. E. States and Canada.	Bellyrail and part of the Framing.
Cedar.	Florida and S. America.	Hammer Shanks.
Pear Tree.	Native.	Damper Heads.
White Holly.	England.	Hoppers, Levers, etc.
Sycamore.	Native.	" " "
Ebony.	Ceylon.	Black Keys.
Spanish Mahogany.	Cuba.	Veneers.
Oak.	Native and England.	"
Rosewood.	Rio Janeiro.	"
Black Walnut Beryl.	Native and France.	"
Satin Wood.	East Indies.	Decoration of Cases.
White Holly.	England.	" "
Zebra Wood.	Brazil.	" "
Lance Wood.	West Indies.	" "
Beryls.	Native.	" "

WOOLEN FABRICS.	WHERE OBTAINED.	WHERE USED.
Felt and Baize (all colors).	Home Manufacture.	Front and Back Rail of Key Frame, Stemrail, etc., for Keys and Hammer Stems to fall on.
Cloth; various kinds and qualities.	" "	Bushing Pivot-pin Holes throughout action; Damper Wire Holes, and certain other places, to prevent rattling and jarring.
Rubbing Cloths and Felts.	" "	Polishing Case and Ivory.

WOOLEN FABRICS.	WHERE OBTAINED.	WHERE USED.
Silk.	Home Manufacture.	Lining of Upright Fronts.
Braid.	" "	Weaving between dead end of Strings to prevent rattles.
Felts, Hard.	" "	Hammer Heads, White external Covering. Brown or Yellow under Covering. Wedge Felt for Dampers.
Felts, Soft.	" "	Soft Dampers, Hammer Heel, Jack, and other places.
Flannel (all colors).	" "	Action.

LEATHERS & SKINS.	WHERE OBTAINED.	WHERE USED.
Doeskin, Calf.	Native.	Various parts of Action.
Basil, Elk.	"	" " "
Buck.	"	Under covering Bass Hammers.
Sheepskin.	"	Punchings.
Morocco.	"	Buff Stop in Square Pianos.
Raw-hide.	"	Buttons for Action-props, Damper Shade-wire, Pedal Feet-rods, etc.
Buckskins.	Germany.	Capping Hammers.
" Red and Brown.	"	Actions.
" Black.	"	Punchings.
Chamois skins.	France and Germany.	Polishing and Cleaning.
Ivory.	Africa, India and Siberia Fossil Ivory.	Tops of White Keys
Celluloid.	Home Production.	Fronts of White Keys.
Black Lead.	" "	Fortops of Wood Bridges, and to smooth rubbing surfaces of Jacks, and other parts of Action, where required.

METALS.	WHERE OBTAINED.	WHERE USED.
Iron.	Native.	Iron frame or Plate, Agraffes, Bolts, Brackets, and various Props, Screws, Springs, Castors, Bridge and Plate Pins, Washers, Pedal Feet, Hinges, Locks, etc.
Steel.	"	
Brass.	"	
Gun Metal.	"	
Copper.	"	
Wrest or Tuning Pins.	Norway Iron.	Tuning Pins.
Steel Wire.	America, England, and Germany	Strings.
Soft White Wire.	" " "	For covering Bass Strings.
Copper Wire.	" " "	For covering Bass Strings.
Wire Netting.	" " "	Back of Uprights.
German Silver.		Covering front of Stemrail.

VARIOUS.	WHERE USED
Glue.	For gluing Case and Action throughout.
Varnish.	Filling and finishing Case.
Shellac.	" " "
Oils, various kinds.	" " "
Alcohol.	" " "
Logwood.	" " "
Red Sanders.	" " "
Extract of Rosewood, or Rosewood Stain.	" " "
Polish, various kinds.	" " "
Fillers for Veneers.	" " "
Materials for Ebonizing.	" " "

VARIOUS.	WHERE USED.
Beeswax.	Finishing Case.
Asphaltum.	" "
Zanzibar Shellac.	Sound-board.
Sandarach.	" "
Sand and Emery paper and cloth.	In Construction.
Japaning, Bronzing, Gilding and Decorating.	Iron Plate.
Lamp black.	Blacking Keys below Ebony.
Rubber Tips and Rubber headed nails.	{ Tops, Fallboard, Music Desks. Cap for bolt of Action Bracket.

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